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WE INVITE PRACTICAL ARTICLES ON THE TRADE IN ALL ITS BRANCHES, WHICH WILL BE PAID FOR MSS. SHOULD BE WRITTEN ON ONE SIDE OF THE PAPER ONLY.

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DECEMBER 4.

British Foundrymen's Association (Manchester Branch).—"Carbon: Its Properties and Relation to Cast Iron," by R. H. Greaves, B.Sc.

DECEMBER 11.

British Foundrymen's Association (Birmingham Branch).—"Cores and Core-binders," general discussion.

British Foundrymen's Association (Sheffield Branch).—"The Foundry and the Man," by W. H. Sherburn.

NOTES AND COMMENTS.

Brass Melting and Losses.

It is well known among brass founders that a little variation from the proper method of melting down copper and zinc to make brass mixtures will often result in bad castings. It is also well known that losses of metal which occur during the melting process are often considerable, and make a hole into the profits that would otherwise accrue to the founder. But not so well known are the exact conditions that make for success in the work. After the zinc, etc., has been added to the copper, and the whole has been covered with charcoal or some other fluxing material, little danger is incurred; but when copper alone is first put into the crucible the oxide which is formed is absorbed again, a new surface of molten metal being presented to the effects of the air or gases. This results in bad castings, and also it is not so easy to tell whether the copper is being overheated as when there is zinc present.

Melting the copper alone cannot always be avoided, but when scrap metal has to be used up, a much better method is to place some of that into the crucible with the ingot metal. Since the melting point of brass is considerably lower than that of copper, it will melt first, and the zinc, by giving off an oxide which forms a film that remains on the surface, will offer considerable protection to the copper as it comes down. The zinc also acts as a deoxidiser to the copper as the latter melts. When the copper has entirely melted the addition of more scrap to complete the mixture should be made, and the spelter added at the right moment; that is to say, when the mixture has arrived at a point where the spelter can be added and will properly melt and mix without undue loss. Copper losses through over-heating, and also the consequent trouble of blow-holes, sponginess, etc., through burnt copper, are very liable to occur in melting down those alloys that do not contain zinc, and in such cases considerable care has to be exercised. There is also likely to be a considerable loss of spelter through oxidation if the conditions are not regulated carefully and this metal added at the right heat. This trouble is so well appreciated that one American inventor has patented a process for keeping down the loss in brass-melting by melting the zinc first and then adding the copper. The zinc is first melted in a crucible in the ordinary manner, covered with charcoal or borax, and the copper in small shape, such as shot, is then put in, the whole being allowed to stand in the fire until the brass has formed. This process appears at first to contradict the laws of metallurgy, as the melting point of zinc is only 412 degrees C., and its boiling point 1,040 degrees C.; while the melting point of copper is about 1,090 degrees C., and that of brass somewhat less than 1,000 degrees. It appears, however, that the copper begins to dissolve and form brass at a much lower temperature than its own

melting point, and by this means it is not necessary to raise the zinc above the melting point of the brass. This is an important point, for it reduces the losses of zinc to a comparatively trifling amount, though if the melting point of brass is exceeded the virtue of the process is necessarily nullified.

In the ordinary method of alloying zinc with copper, however, the best method is to place a little scrap metal and a handful of common salt in the bottom of the crucible with the copper. A covering of charcoal should then be added, and the metal brought to the melting point, after which the rest of the scrap should be added. The addition of more salt after the copper has been melted has often been found advantageous in reducing the oxides. The use of salt in brass melting is not fully appreciated by many founders, though its effects are very beneficial. Salt at a red heat splits into sodium and chlorine, the sodium acting as the reducing agent, and to such purpose, that if copper is kept covered with it, practically no oxide will be formed. It should be borne in mind that throughout the whole process of melting the brass charcoal must be supplied to completely cover the metals as they melt, in order to protect them, taking care to keep all the contents of the crucible below the rim, or the charcoal will not serve its purpose. Finally, the metal should be poured directly it is ready; to let it stand in the fire, waiting, say, the convenience of the moulder, is to risk bad castings, no matter what care has been given to the actual melting of the metal.

The Use of Charcoal.

Despite the fact that the use of charcoal is familiar to every brass-founder, the real fundamental principle underlying its use is frequently not understood. This is evidenced by the amount of discussion on the subject that has taken place from time to time. Commenting on this fact, "The Metal Industry" remarks that when someone not thoroughly familiar with chemical reactions tries the use of charcoal in brass melting and results are not satisfactory, the process is condemned as wasteful and expensive. As is well known, copper, the principal component of brass, is very susceptible, when in the process of melting, to oxygen. It thereby forms the first of a series of oxides, cuprous oxide or CuO; this oxide the metallic copper is capable of dissolving. The mixture thus made renders the resulting brass cold short, or brittle while cold, and as practically all brass mixtures are worked cold this is very detrimental to the successful manufacture of good brass. When charcoal (chestnut size is best) is added to a pot of brass or bronze a partial oxidation of the carbon of the charcoal takes place at once. This is due to the combination of the carbon with the oxygen of the draft, forming carbon monoxide or CO. Carbon monoxide is an excellent reducing agent in that it takes up an additional atom of O and forms thus carbon dioxide or CO_2. This second portion of oxygen is derived from the metallic oxide already formed by the metal. This reaction would be expressed by the formula $CuO + CO = CO_2 + Cu$. The carbon monoxide, therefore, robs the copper oxide of one molecule of oxygen, thus liberating the copper in its original state.

Now comes the really important stage of the process. It must be kept in mind that when the carbon dioxide has been formed this is as far as the reaction can go. If means are not now provided for the retention of the protective cover of carbon dioxide, the charcoal will be speedily used up and the copper will oxidise as before. The remedy lies in not filling the pot with molten metal within less than 2 in. of the top. This gives an opportunity to keep a layer of charcoal completely covering the metal, and what is more important, a layer of carbon dioxide gas, thus effectively preventing further oxidation. Carbon dioxide—carbon anhydride—carbonic acid gas is a heavy inert gas that does not support combustion. It has a specific gravity of 1.52, hydrogen being 0.062, and a vapour density of 22 where hydrogen is 1. If the metal in a crucible is level with the top (as is often the case) the heavy carbon dioxide formed at the expense of charcoal is immediately forced over the edges of the pot and its valuable effects are lost. By observing this very simple precaution there is no flux or deoxidiser for brass easier to apply than charcoal, but, as can be seen, it is equally easy to sidetrack its most valuable quality.

The Revival of the Apprenticeship System.

On the occasion of London's annual civic festivities last month, Sir John Knill, the Lord Mayor, declared that he was determined to work for the revival of the apprenticeship system, and the raising of the standard of work produced by the various craftsmen. Following this pronouncement a considerable amount of correspondence on the subject was published, and eventually it was announced that the Lord Mayor had undertaken to convene a conference to meet the Chairman and members of the London County Council to discuss the question of industrial training in education and the development of trade schools, and, in connection therewith, (1) the position of apprenticeship and of the apprenticeship charities; (2) the establishment or development of employment bureaux or other means of bringing those leaving school into touch with the industrial and commercial world.

In the correspondence referred to a number of suggestions were put forward. According to Mr. A. J. Penty, the well-known author of "The Restoration of the Guild System," technical schools are no substitute at all for apprenticeship, as boys all learning in a class together do not pass on in a rational way from stage to stage; they learn *en massé*, and so there is no real individual growth. The schools can help in a theoretic way, but there is no possible substitute for a sound, practical training. As to apprenticeship, he considered the decay of the system was due to the disappearance of the small workshop, and that in turn was due to a lack of any general appreciation of the artistic quality of work. He did not object to machinery as such, but contended that machinery is incapable of producing objects with "temperament"—of producing what in the final resort can be termed artistic. He is convinced that any movement for the revival of the apprenticeship system that does not emphasise the importance of reviving the crafts—not merely as commercial, but as artistic concerns is doomed to failure. The reason why the word apprentice has no meaning in a factory is that there must be personal relation. But something, he thinks, could be done. In the old Guilds the apprentice was articled to the Guild as a whole, and let out to a master. This example he suggests the Trade Unions could follow. The lad would be apprenticed to the society, and they would have to look after him, be responsible for him, be his technical godfather.

The opinion expressed by various authorities appeared to favour the revival of the apprenticeship system, but Sir Charles Dilke, whose right to speak authoritatively on Trade Unionism is unquestioned, stated that he was not certain of the effect that would follow the re-establishment of apprenticeship.

It had been in many industries the excuse for sweating; it had in Australia and elsewhere given rise to complaints of the undue proportion of young men introduced into the trades. Professor Lethaby, a pioneer of technical education, and perhaps the first living authority on the mediæval guilds and their relation to modern movements in arts and crafts, who also contributed his opinion on the subject, thought it distinctly advisable that a system of apprenticeship should be organised in which the lads entering trades should be indentured directly to the Unions.

It cannot be denied that we are passing through an evolutionary stage in our industrial life, in which the tendency is to create mere operatives in place of competent craftsmen who possess the capacity of initiative. At the same time, the standard of British workmanship can hardly be said to be deteriorating, for the movements which are on foot in various directions to elevate the worker are having a considerable and commendable effect. But these movements tend rather to touch the better-class worker than the lower grades which we referred to, and so, while one section is becoming more efficient another and large section is becoming more and more the slave of the retrograde tendency to produce operatives who can perform a few mechanical duties, but who can in no higher sense be termed competent workers. We have at various times commented on this tendency as being an unpleasing contrast to the old system of apprenticeship, and we still maintain that apprenticeship has many virtues. But it must be remembered that the system died (or became practically inoperative in a number of trades) because it failed to meet the conditions of modern industrialism. In the past, in the majority of cases, apprenticeship worked satisfactorily, but with the introduction of mechanical appliances there gradually grew up in many quarters the tendency to keep apprentices at certain specialised operations, at which they soon became efficient, and at which, owing to their low wages as compared with full-priced workers, they could earn a good return for the employer. This system obviously can not result in the apprentice properly learning his craft, for under such conditions he leaves at the expiration of his apprenticeship with but the barest knowledge of his trade as a whole, and gives place to another low-priced youth who goes through the same process of training. This is, perhaps, only one of the causes that have contributed to the decline of the apprenticeship system, but it indicates the direction in which reforms must be made if any revival is to take place. There must be some guarantee that the youth will be taught his trade by competent men; there must be some authority inspecting and guarding the training of the individual apprentice; and what is perhaps as important, provision must be made for the payment of the necessary premium in cases where the parents cannot afford it. This latter would at once open up a career for the smart, intelligent boy who at present too often drifts into the lower ranks.

Whether the Trade Unions could successfully undertake this work it is difficult to say. It must not be forgotten that they are primarily instituted to maintain minimum wages and decent working conditions, and that they are often even now engaged in hard industrial warfare. This feature alone might in some cases be prejudicial to their influence in such an educational movement as the revival of apprenticeship, but at the same time some such strong organisation is necessary to carry out the work; in fact, organisation is the key-note of the whole scheme. Whatever body undertook this work would find a great field before them, though high ambition and considerable statesmanship would be essential. But Britain does not lack men who are capable of taking up the organisation and responsibilities of the work, and it is quite possible that the Lord Mayor's conference will stimulate to activity the desired movement.

An Aluminium Non-flux Solder.

In view of the difficulty that has been experienced in soldering aluminium, a considerable amount of interest is attached to a demonstration of the use of a special solder, which we witnessed recently. The great trouble, as is well-known, in soldering aluminium has been to get rid of the oxides that form either from the solder itself or from the aluminium, and even with the greatest care and the use of fluxes the resulting joint is liable to be nothing more than an imperfect adhesion of the solder and the metal. The tendency has also been noted for the soldered joints to lose their original strength after a time, particularly if the solder contains tin. In the solder referred to above, however, it is claimed that the much-desired alloy that will give a good joint without the use of a flux has been found, and that aluminium can be soldered in exactly the same manner as other metals which are at present soldered and brazed. The virtue of the process lies in the composition of the alloy or solder itself, as one of its components is stated to have the effect of reducing the oxide, or driving it off as a vapour, on the heat for the soldering process being applied. This does away with the objections which are associated with the use of a chloride, which is contained in the majority of fluxes for aluminium. The solder is applied without any flux, either directly or indirectly. A steel "bit" is substituted in place of the usual copper one, as copper in contact with the aluminium is undesirable, and before soldering, the surface of the aluminium is scraped or filed, to get rid of any dirt or objectionable matter, and especially the oxide. The parts to be soldered are then "tinned" in the usual way with the solder itself, and when this has been properly done the parts are placed together with sufficient solder in between to effect a proper and permanent joint. The hot steel "bit" should then be applied and held in position until the solder oozes, and on the parts being cooled a good joint results. The solder has practically the same appearance as the aluminium itself, and can also be used with a blow pipe. It may also be noted that it is claimed to be equally efficacious in making joints between aluminium and other metal, and to give a surface that will take ordinary solder. This is an advantage in joining other metals to aluminium, for the joint, after the aluminium has first been "tinned" with the non-flux solder, can be filled with ordinary solder. This non-flux solder should prove very useful in the aluminium foundry, for it can be used for filling up blow-holes in castings and for repairing broken or cracked articles. The solder itself is very ductile, and has a high-tensile strength, examples tested at a well-known motor works in this country demonstrating this; in each of the cases shown to us the joint had remained intact while the aluminium had broken. It is stated that the solder does not deteriorate under atmospheric conditions. This material is, we understand, not a new invention, and has been successfully applied to a number of purposes, but until recently it has not been placed before the public. It is now being supplied by the Aluminium Non-Flux Solder, Limited, 10, Camomile Street, London, E.C., a provisional patent having been taken out.

An Aluminium Foundry on the Unit System.

Some interesting particulars of the foundry plant now being constructed at Detroit (U.S.A.) by the Aluminium Casting Company, are given in our contemporary "Casting," from which we take the following:—

In connection with the construction of the plant in question, there has been devised a unit system which is so arranged as to fit the requirements of the case in remarkable style. In Fig. 1 is shown one-half of the installation, or five of the ten units, which will make the plant proposed for the present. The system reaiiy resolves itself into the construction of a series of small foundries which are all operated under a single roof by the one management. Each foundry is independent of the others and under a separate foreman, there being one superintendent over the entire plant.

In the new Detroit works only aluminium is to be cast in the part now being constructed, and hence the entire equipment is arranged for this metal. The general layout is shown in Fig. 1, and it will be noticed that for the present No. 1 unit is utilised as a grinding department and shipping-room. Ultimately as the plant is extended some of the new units will be used for brass or bronze. As brass and bronze foundries require less space for core room, the grinding and cleaning room for each such unit will occupy a portion of the space set aside for core room. This arrangement will keep the grindings as well as the gates and scrap from each brass or bronze unit within the unit, and so avoid mixing of metal. So far as possible each unit will be kept for a single composition of metal. The cleaned castings from the brass or bronze units will be trucked through the central passage to the shipping room.

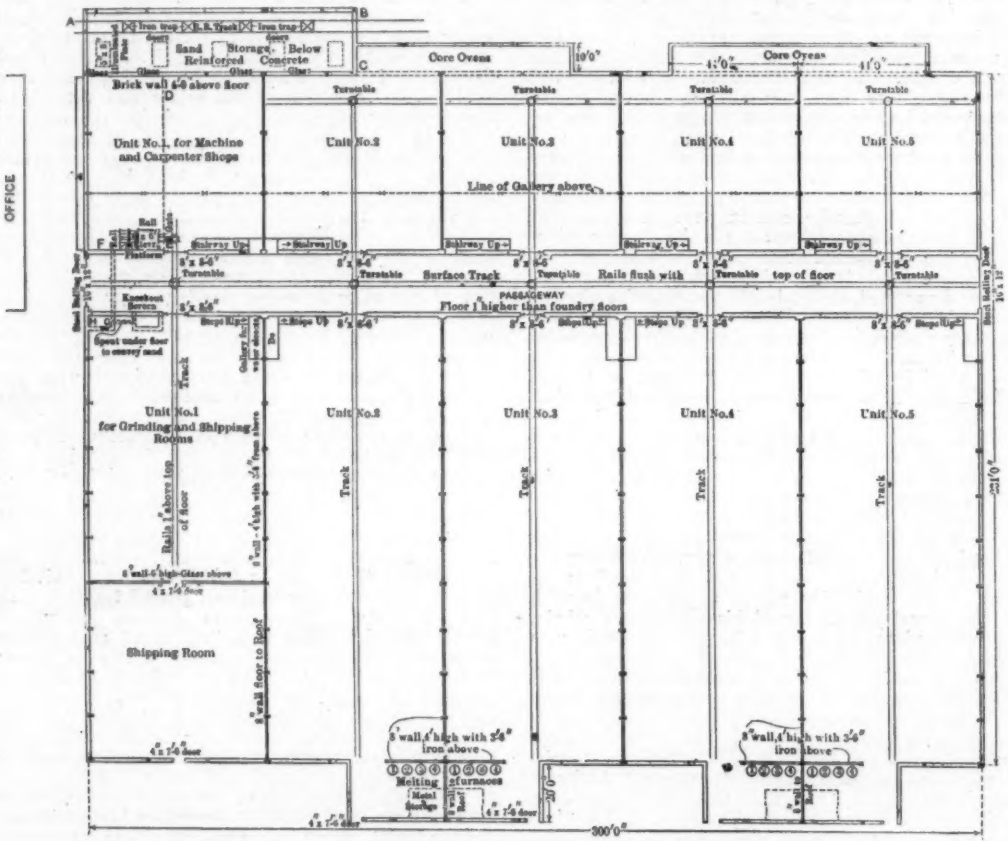


FIG. 1.—PLAN OF FIVE UNITS OF THE ALUMINIUM CASTING COMPANY'S PLANT.

The plant for preparing sand for the entire works is in the basement, partially under the No. 1 unit, the outline of the basement being shown on the drawing by the letters A, B, C, D, E, F, G, H, and A. The sand is received on the railroad track at the side of the foundry and discharged through iron chutes into the sand storage, which is outside of the building proper. The mixing machinery is under the portion of No. 1 unit which will be used for a machine and carpenter shop.

Many of the aluminium castings will arrive at the cleaning department with cores still in them. These will be removed over the knock-out screen and the sand will escape through a chute into the corner of the basement shown at G. This old sand is blended with

new sand in making the core mixture. The sand for the various core-rooms is conveyed to them by belt conveyors.

Core Rooms.

On the class of work made at the Detroit plant it has been found that the core-room should occupy 40 per cent. of the area of the foundry and this building has been laid out to meet these conditions. Provision has been made, however, which will make it possible to shift the partition wall between any two core-rooms so as to decrease the size of one and increase the size of the other.

The core-ovens are in small lean-tos or additions at the side of the foundry as in Figs. 1 and 2. The ovens will be so arranged that the core cars pass through them, the green cores entering at one end and dried cores emerging at the other.

The core-makers' benches will be along one side of the room as well as in the centre. On the other side of the room the cores which come from the oven will be pasted and prepared for use in the foundry. Each foundry receives cores from its own core-room, and is also provided with its own melting room, which is in a lean-to structure on the side of the building opposite the core-room, as shown in Figs. 1 and 2. The metal storage room is also in the small building housing the melting rooms.

Crane Service.

Each foundry will be provided with two travelling cranes, which span one-half the width of the foundry. In other words, a runway is supported from the roof trusses along the middle of the foundry and travelling cranes work on each side of it. The cranes are only necessary for turning heavy flasks.

The property owned by the company makes it possible to add as many more units as may be required. The addition of more than ten units, however, would require a larger grinding and shipping room. In case it is necessary to increase these departments in the future, the space next to the office building will be utilised as a shipping room, and the capacity of the present shipping department added to the grinding room.

Separating the core-rooms and foundries of the separate units there is a broad passage extending the entire length of the structure and connecting all of the separate foundries. Through this passage the castings will be taken from the foundries to the cleaning department, and patterns and other supplies brought to the foundries. Opposite the melting rooms there is a wide yard so that each unit foundry has ample flask storage facilities.

Lighting and Ventilation.

One of the special features of this foundry is found in the provision for abundant light. This is shown very clearly in Fig. 2. The upper illustration shows the side of one of the unit foundries. It will be noted that there is glass the entire length of the monitor roof in both the foundry and core-room departments. All units will have side light from their monitors and as the monitors are high this will give a large amount of illumination. The glass in the sides of the monitors is 10 ft. 6 in. in height the entire length.

To provide for ventilation the entire building has been equipped with sashes on the sides of the monitors, in two series, and equipped with opening devices so that the sashes can be thrown out at the bottom. Over the melting-rooms, ventilators in the roof have been provided. The glass in the melting-

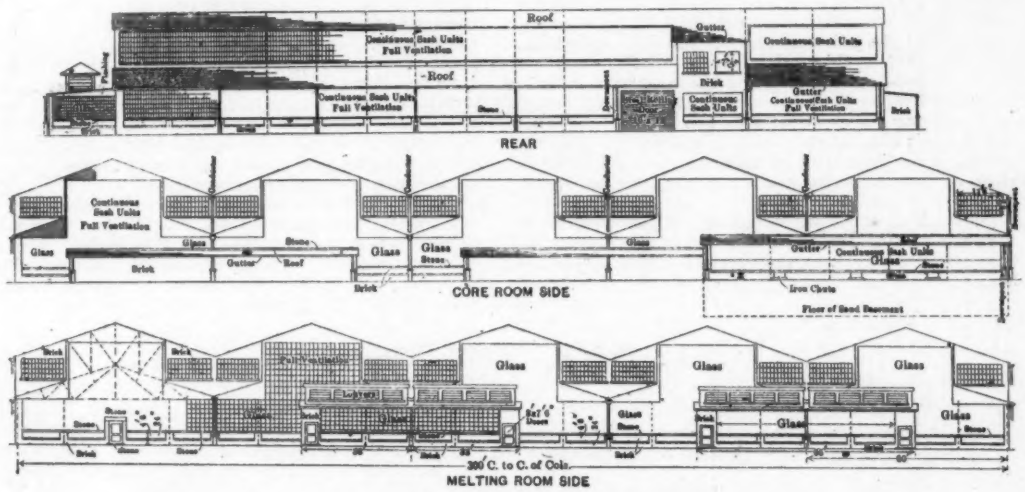


FIG. 2.—ELEVATIONS OF THE UNIT FOUNDRY.

The roof of this foundry is made of reinforced concrete tiles made by the Reinforced Tile Company, Youngstown, Ohio. These tiles are about 4 ft. in length and are supported on the steel, thus making a fireproof roof of simple construction.

Sanitary Arrangements, etc.

The sanitary arrangements in connection with the foundry have been worked out very carefully. Over each core-room there is a gallery extending across the room and containing the wash-rooms and lunch-rooms for the men. One end is given up to coremakers and the other to the moulders. Tables and benches are provided for the men while eating. Their clothes are taken care of by means of numbered hooks on the wall and above the hooks there is a shelf upon which the men may place lunch boxes or dinner pails. No one will be allowed in the lunch-room during working hours, a regulation that cuts out any possibility of pilfering, which has been found a great annoyance in some coat-rooms. As the men from each unit are

provided with their own coat-room and lunch-room, each foundry is as independent as though it had no connection with the other in any way. The toilet facilities have been very thoughtfully considered and the equipment provided is of the best.

For the moulders there is a urinal on the foundry level, and the closets are arranged in a gallery just above it. In the core-room the toilet facilities are all on the floor level. The lunch-room is reached by a stairway leading from the main passage connecting the foundries up to the gallery, as shown in Fig. 1. These stairways can be entered either from the core-room or from the passage, the moulders entering from the passage, and the coremakers from the core-room. The toilet facilities for the coremakers are located beneath these stairs while the location of the toilet facilities in the foundries is shown on Fig. 1.

Advantages of Unit System.

Some of the advantages of the unit system in foundry construction are as follows:—The work for different companies varies in character; that is, the castings to be furnished to one concern may be far more difficult to turn out than those for another. This difficult work can all be centralised in one unit under one foreman. Naturally this unit would be given the most skilled workman in the entire organisation, and the other foundries would become training schools for this unit. Many of the moulders would naturally want to get to the best work with its corresponding higher pay, and so there would always be a striving for promotion to the department turning out this class of product. When various classes or grades of castings are produced on one floor the lower class of work always has a tendency to lower the grade of the higher work.

On work of equal grade the separation afforded by the unit principle will naturally give opportunity for comparing the work of the various foundries and the best methods and devices brought out by the several foremen will be available for application in other departments. Modern practice in the cheapening of output is accomplished more by labour-saving methods than by trying to get a larger day's work from men with rigging formerly in vogue. When two or three men who are separated from one another are each set to work to solve the same problem they are sure to develop different methods. The comparison of these methods and the adoption of the best points from each results in a much better method of doing the work than could be devised by any one man, or in many cases by the three working together, for when several men are working together one of them usually takes the lead and impresses his opinion on the others.

Another and very important reason for adopting the unit system is that it makes it possible to keep track of foundry costs of any particular line of foundry castings much more accurately than would be the case were all of the workmen in one large foundry. Still another advantage is that for various classes of work slightly different alloys are required with the aluminum. This unit system will serve to keep the metal separated. The location of the foundries side by side reduces the transportation work between separate units and the cleaning department to a minimum, and also makes it possible for the general superintendent and others interested in the work of the separate foundries to pass from one plant to another with the minimum of effort.

In the event of slack times, with the unit system it will be possible to shut down one or more units and at the same time keep the others running at their full capacity and in the most economical manner, which is not possible in the case of a large foundry where all the men are located on one floor.

The provision of a separate core-room for each unit reduces the distance the cores must be transported to place them in the moulds, and this saving of steps and conveyance, in turn, minimises the loss from broken cores.

A New Aid to the Brass Foundry.

Numerous fluxes have been placed upon the market from time to time for the purpose of removing impurities from alloys having copper as a base. Most of these are either in the form of alloys charged with the metal or of fluxes added either during the melting period or at the end of it, when they are stirred in. The Allyne Brass Foundry Company, Cleveland, U.S.A., has carried on a series of extensive experiments to develop a compound which would purify any metal having copper as a base. It was recognised that the compound must contain a copper or brass alloy to carry the necessary chemicals into the castings. These experiments finally resulted in a compound which has been named "Homogen." This compound is a black powder, and is composed of a copper-bearing alloy which has been reduced to a fine powder and then treated with suitable chemicals so as to coat each particle of the alloy with the desired ingredients and bind them or blend them into a homogeneous mass, so that the copper and associated metals will carry the chemicals into the mixture as melting proceeds.

After extensive experiments with "Homogen" it has been proved that it is best to introduce the material into the pot at the time the metal is introduced, and also that it is advisable to place it in the bottom of the pot, so that it will melt with the first of the metal and treat or affect the charge as it is melted down. In practice, if the charge consists of scrap and ingot metal, the pot is charged and then the cleansing material poured over the contents of the pot. In this way it becomes thoroughly distributed among the charge. When turnings are to be melted the material is mixed with the turnings before they are charged. It may be used in oil-fired furnaces as well as in crucibles. It serves, it is claimed, to eliminate gases and to flux out such impurities as iron, thus resulting in a much denser and stronger casting. Many experiments have been made to test the advantages of "Homogen" with various alloys, including manganese bronze, United States Government 88-10-2, red and yellow brass. These all showed an advantage of between 5 and 10 per cent. increase in strength and a very much greater increase in the elongation and reduction in area of the test-bars. It is in the case of hydraulic tests, however, that the results are said to show the greatest benefit from this treatment.

Wooden Pattern Plates for the Jobbing Foundry.

By J. R. Moorhouse.

The application of moulding machines in the jobbing foundry has been the means of developing many novel and ingenious arrangements for making plates and mounting patterns, with the object of reducing the expense of mounting and allowing in a measure the advantage of a moulding machine to be better appreciated by the jobbing foundryman. The use of cement, litharge, and wooden plates has accomplished a great saving in this direction. It is not here intended to discuss the cement and litharge match-plates, or the well-known principle of mounting pat-

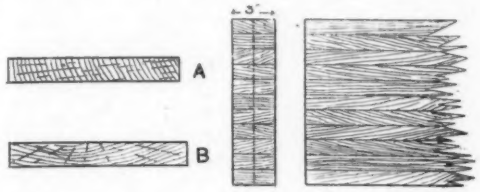


FIG. 1.

FIG. 2.

terns on metal plates, which is generally adopted in speciality shops, but to treat with the use of wooden plates that may profitably be adopted in a jobbing foundry making from twenty to a few hundred castings from one pattern. Apart from a moulding machine, plates can advantageously be used, because they save time in drawing the patterns from the mould, especially if a number of castings be located on one plate, and also ensure castings being alike, a feature that is of great importance if the castings are to be placed in jigs for machining. A still further advantage is gained in foundries where an air pressure line can be used to operate vibrators, attached to these plates in such a manner that upon the with-

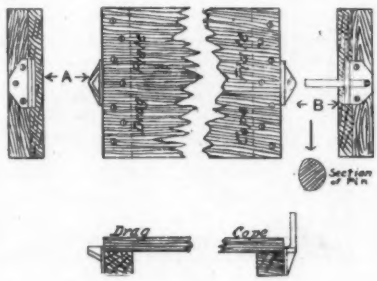


FIG. 4.

drawal of the plate, the patterns are vibrated and freed from the mould. It is advisable, however, in order to further economise, to instal a machine, the rock-over types being particularly suitable, because the expense of stripping plates are avoided. The simplest and least expensive patterns to mount are the flat-backs. The term flat-back applies to patterns with a perfectly plain cope face, the pattern being wholly in the drag part of the mould, and for this particular class of pattern mounted on a rock-over machine, no pins or sockets are necessary to be attached to the plate, since the cope being a plain part has nothing to match. These plates, however, can very readily be changed for a match-plate should the supply of flat-back patterns be insufficient to keep the machine in operation.

The material for wooden plates may be pine, teak, cherry, or mahogany, of a thickness sufficient to stand the pounding of the rammer, which, of course, will vary according to the size of flask used. Whatever kind of lumber be used for these plates it should be cut in such a manner that the annular rings are approximately at right angles to the face, as shown in Fig. 1 at A. The grain, shown in the piece B, would have a tendency to warp, however much it were

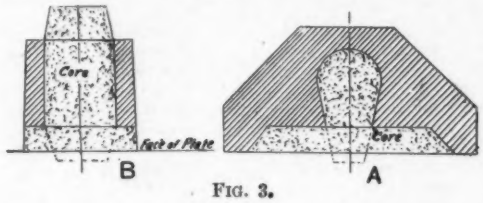


FIG. 3.

protected by varnish. A good and serviceable plate can be made by using yellow pine cut in a manner as previously described, but $\frac{1}{8}$-in. thicker than the finished size required, cut up to length and boiled in paraffin for eight or ten hours, and then allow to cool off in it during the night. Plates so treated are not susceptible to the dampness and other trying conditions of the foundry. Another method is to take 3-in. stock free from knots and run off 1-in. thicknesses with the saw. These are glued up, as shown in Fig. 2, and when the glue is set a saw cut is taken through the centre, as shown by the dotted lines, thus forming

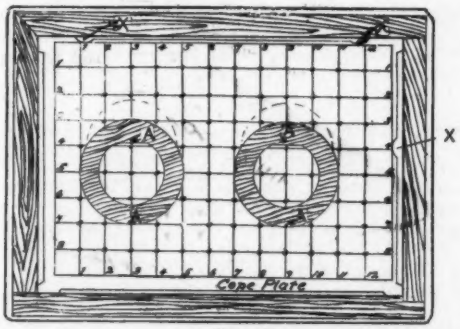


FIG. 5.

two boards which are trued up to size and then given three coats of shellac varnish. If battens are necessary to strengthen the plates they should only be screwed, and not glued. Otherwise, if the plate should dry the battens would draw it out of truth on the surface. On plates set with flat-back patterns and intended for use on a rock-over machine, either the ordinary metal flask may be used or a snap flask. It is quite immaterial how the box is set, providing margin is given to allow of sufficient sand between the patterns and side of the flask. Four corner pieces of wood screwed to the plate are quite sufficient to

lead the flash into position in relation to the patterns. The setting of flat-backs requires no skill, and is usually done by the operator. Instances are rare, however, where a machine can be entirely run with flat-backs, although by the use of cores much can be so worked that would otherwise require a match plate. Fig. 3, A, is an example, and shows a section which will explain itself, the dotted lines showing the original pattern. Fig. 3, B, shows a bush pattern that ordinarily would require prints on a match-plate to ensure the correct alignment of the core. The core, if made as illustrated, allows this to be mounted on a plain plate, and avoids the expense of a match-plate. Numerous examples could be given where twisted parting lines could be very much simplified

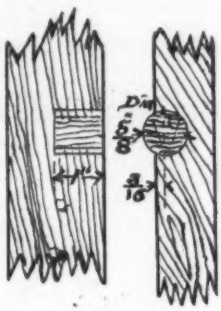


FIG. 6.

by the judicious use of cores, and made so that any ordinary plate could work them off a machine, as previously explained.

Coming now to the split patterns and those having irregular parting lines, we must have what is considered to be a stumbling block to many founders, who naturally hold the idea that to ensure a good joint at the parting line the expensive outfit of interchanging flasks with machined metal plates, and metal patterns, is necessary. Where there are thousands of moulds required from one pattern, and for really first-class work, these are certainly to be preferred, and are usually adopted in speciality shops, as instanced in cash-register patterns, etc. In the average jobbing foundry, such a quantity of casting from one pattern is extremely rare, and to benefit by

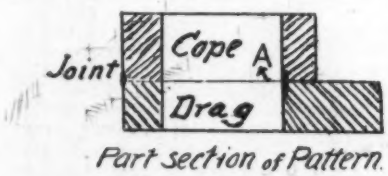


FIG. 8.

adopting plates and machine moulding, some cheap method of making them, and mounting patterns, must be resorted to. If metal interchanging boxes are to be used in conjunction with wood plates, preferably the vee socket, as shown at A in Fig. 4, should be secured to the plate, the pins on the flask, if possible, being always attached to the drag part, so that any slight movement of the board due to the varying temperatures and working conditions of the foundry will not jam the pins of the flask to the sockets of the plate. For the cope part, the pins, as secured to the plate, should be only just sufficiently long to cover the lift of the depth of the pattern, and of a D section shape, as shown in Fig. 4, B, which permits of a certain amount of freedom for the creep of the plate. For wood flasks or snap flasks the same principle applies. (A vee section pin, working into a vee socket, as commonly adopted in snaps, works quite satisfactorily, and is preferable, apart from a reversible pattern plate, because it does not allow for adjustment to the extent of a round pin working into a vee socket, as will be shown later.) For split patterns we may use either two plates containing one half pattern to each plate, or one plate to work both halves of the pattern. The size of the snap flask to be used, and the pattern to be moulded, decide which of these two methods be adopted.

As regards mounting patterns using two plates, the pins and sockets can be secured to the battens on the underside of the plate, as shown in Fig. 4, and must

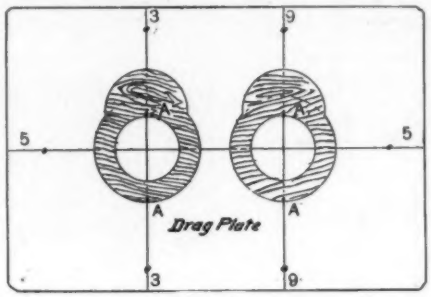


FIG. 7.

allow a smooth working fit for the snap or flask the full length of the pins. It is important that when a snap flask be used that it be sufficiently strong for the purpose, as a gingerly constructed snap flask will leave over-shot castings. To locate the patterns on the plates a quick and fairly accurate method is for the moulder to take a sand impression. The drag half of the pattern is first secured to the drag plate in its correct position, the drag half of the flask placed upon it and rammed up very hard, and with a facing of finely-sifted sand. The plate is then drawn, and the face of the mould dusted with finely-powdered chalk. The cope half of the snap is now rammed in

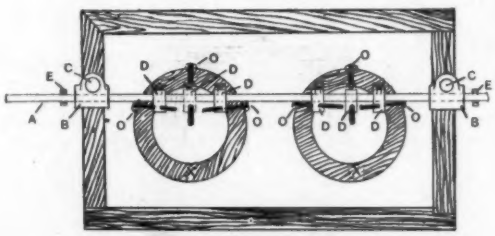


FIG. 9.

a similar manner on the plain cope plate, then removed and placed on the drag half. By this means an impression is outlined on the cope by the powdered chalk on the drag whitening the cope face of the mould. The cope plate is now smeared with a mixture of fine gas-black and oil, and upon this is placed the cope part, with its impression from the drag, which, in turn, transfers this to the plate. The chalk, by adhering to the oil, outlines the position for the cope half of the pattern on the black background of the plate. This is now secured to the plate and the oily gas-black removed by waste steeped in wood alcohol. If care has been duly exercised a good joint at the parting line of the castings should be obtained.

It is often required that patterns shall be located on the plates and completed previous to being sent to the foundry. This is usually done by the pattern-maker, who has to set out the positions for the patterns on the plates to ensure a correct match, an operation that requires great accuracy and precision. To avoid time and trouble in laying out these pattern-plates, various methods are used, One method is to take a piece of steel or celluloid plate, about $\frac{1}{16}$ in. thick, and 1 in. less than the width and length of the flask. This is taken and marked out, as shown in Fig. 5, in divisions of 1 in., both for length and breadth of the plate and on both sides of it. Through these points are drawn horizontal and perpendicular lines, and where these lines intersect, fine holes are drilled to allow a needle to pass through. The needle may be shouldered similar to those used in drawing instruments. It is advisable to have a plate for each

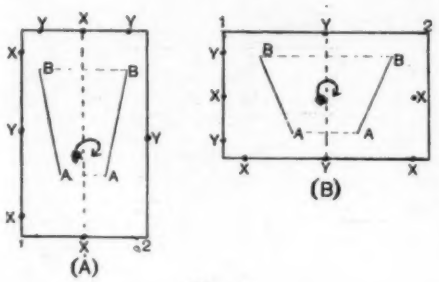


FIG. 10.

standard size of flasks used. If the snap or flask is to be filled out at the points marked **X**, as shown in Fig. 5, and at these points the core and drag must be perfectly even one with the other. The reason for this will be shown later. Should the flask or snap not have iron strips, hard wood pegs may be inserted, as shown in Fig. 6. These are permanent, and must not be removed. A simple method of inserting them is to bore a $\frac{5}{8}$-in. hole, the centre $\frac{3}{16}$ ths from the edge of the box and 1 in. deep, a piece of wood clamped to

FIG. 12.

the side permits this to be done without the drills running out through the side of the flask. A piece of hard wood is turned to fit and glued into place. Assuming the plates are made and fitted to the flask, as previously described, the drag is placed upon the pattern-plate and the lay-out plate taken and placed hard against the projections marked **X**, Fig. 5. The patterns are now placed in a position approximately to where they must be secured. It will be observed that the horizontal line marked No. 5 cuts through the centre of these patterns in the length of a flask and also perpendicular lines No. 3 and 9, cut through the centres in the width. These numbers noted, the patterns are removed, and with a needle the points contained by these lines are pricked through into the drag pattern plate. The lay-out plate is now placed in the cope part, particular care must be taken to keep it hard against the projections marked **X**. The plate, of course, will be reversed to what was face down in the drag, and the same points as marked on the drag plate pricked through on the cope plate. The lay-out plate is then removed from the cope, and these points both on the drag and cope plates cut by lines drawn through them, Fig. 7. It will be evident that the lines on the drag plate must coincide with those on the cope plate, and give the correct

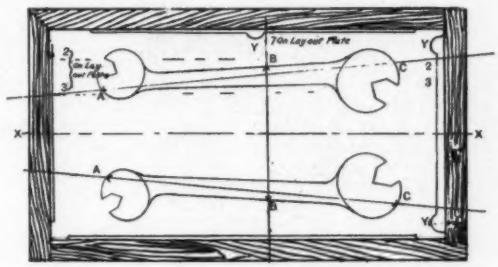


FIG. 11.

position for the patterns. Before placing the pattern into position on the plates, the two half patterns are placed together in their correct relation to each other, and a fine cut with a scriber is made cutting the separate halves as shown in Fig. 5 at A, and in Fig. 8. These will fall on the perpendicular lines on the plates and will place the two half patterns in correct relation one with the other. At the intersection of the horizontal and perpendicular lines, circles are drawn of a diameter equal to the diameter

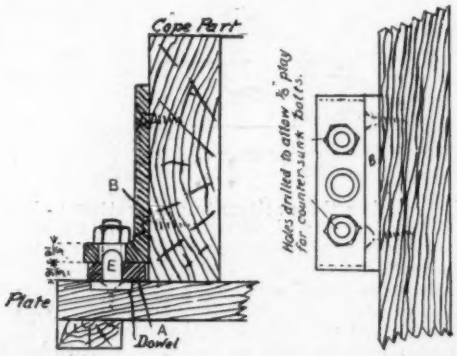


FIG. 13.

of the pattern. The half pattern is then placed to these lines and secured to the plate, which will ensure their alignment at the joints of the casting. By this method any irregular pattern can be set by taking three points marked on the joint of the pattern, and in such a manner that they drop upon lines on the lay-out plate. It may be preferred to set the pattern without the use of lines; this will entail a more ex-

pensive arrangement, which is particularly useful for the setting of any individual pattern on a plate upon which are mounted patterns with varying quantities required from each. The device consists of a number of Starrets mechanics scriber block heads D (Fig. 9) placed upon a steel rod A, secured by clamps B to the flask. The clamps are made fast by the turn-screws E. The steel rod A is tightened by the screw C. Two sets are required to set the patterns, one for the drag and one for the cope. To use them the patterns X are first secured in their proper position on the drag plate, and the desired number of scriber heads D placed on the rod A, which is clamped to the flask as previously described. These scribers have their points ground flat, and are termed setters. The number required will vary according to the shape of the pattern. The example shown (Fig. 9) being a single match-plate. Referring to the diagram Fig. 10, at (A) is shown the plan of a plate upon which is the pattern AA, BB, one half resting to the right of the centre line XX, and the other half to be left. It should be noted that the flask turns in the width of the plate; that is, if a snap flask be used the catch on the drag would drop at the corner marked 1, and for the cope at 2. In locating patterns with a lay-out plate, the patterns marked Y would be used to set the plate. At Fig. 10 (B) is shown the plan of the plate on which the flask turns in the length of the plate, the points marked X, in this instance, being used to set the lay-out plate against. Both the cope and drag parts must, as shown in the diagram (A), drop on the base line Y X Y, and for (B) on the base line X Y X. This may the more readily be understood from the example given

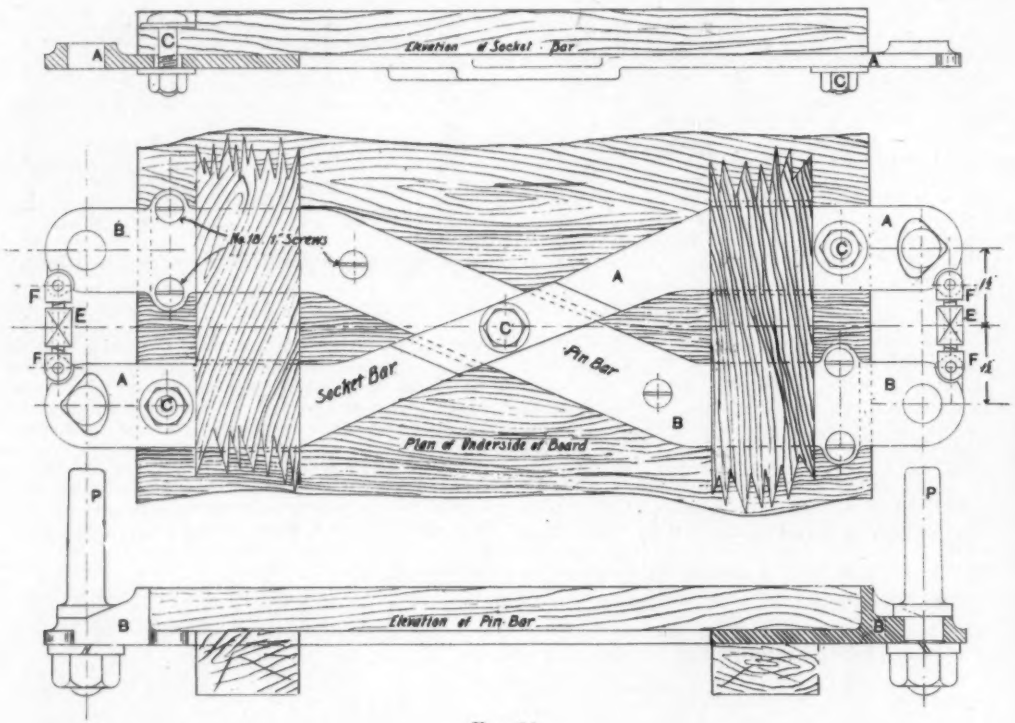


FIG. 14.

circular, requires three setters to each pattern; these are fixed against the patterns at the points marked 0 0 0, and rest upon the plate. The drag part is then removed and turned over. A similar combination of setters being secured to the cope part, it is placed on the drag, the cope setters being carefully placed in line and true with those on the drag part. The cope is now removed with its combination and placed on the cope plate. It is evident that these setters will fall on the plate in such a manner that the mating half pattern, placed against the three points obtained from the drag setters, will assume a correct position in relation to those on the drag plate. The principle of setting patterns with these devices must be understood as being used with two separate pattern plates.

The setting of patterns on a single match or reversible pattern-plate will be more readily followed. There are two ways of working the flask or snap with of a spanner pattern in two halves, to be placed lengthwise of the plate. Having made sure that the points marked X (Fig. 11) on the cope and drag are quite flush with each other, and assuming that the flask has been constructed as previously explained, the drag is now placed on its plate, secured into place by dowels, or other arrangements. A fine line is drawn on the plate, touching the two points X X on the flask, to be hereafter referred to as Y X Y, Fig. 10 (A). The drag, having been removed, the cope is also placed on the plate, and its X X points made to conform to the line Y X Y, as obtained from the drag part. It will be evident that any point taken on the drag at any distance from Y X Y, and from Y to the left of the plate, will be fair with a point on the cope, if the same distance be taken from Y X Y and from Y to the right of the plate. The principle being understood, it is easy to follow the procedure in setting a spanner pattern, though, if

desired, this may the more readily be set by an impression made in a similar manner to that previously explained in conjunction with two plates. This is first placed on the lay-out plate in an approximate position to what it is intended for them to occupy in the flask. It is noted on what lines on the lay-out plate they cover, namely, 2 and 3, on the horizontal, and 7 in the vertical lines (Fig. 11), and a fine mark is made with a scribber on the half pattern at the intersections of the lines drawn through these points. The separate half patterns are now placed together and the fine mark on the one half carefully continued on to the mated half pattern. The lay-out plate is now placed in the drag and the holes accordingly pricked with a needle on the plate. Care, of course, being taken that the plate is hard against the projections marked X, Fig. 11. The cope is then substituted, being similarly and carefully treated, the lay-out plate, of course, being turned over for the cope part. Lines are drawn through these points upon which the patterns are located, and the three fine marks, A B C, are set to the lines on the plate, as shown in Fig. 11. In the use of a single match-plate, with wood pattern plates, means have to be provided to allow the drag and cope to work accurately on the one plate. There are various arrangements used with more or less success. If a rock-over machine is used it is only necessary to locate the flask in relation to the pattern, as the stripping arrangement on this type of machine takes care of the true withdrawal of the pattern from the mould, apart from the pins and ears on the flask, so that the common dowel plates used by pattern-makers will be found to answer the purpose for setting the two-part flask on the plate, in their correct relation to one another, and with the patterns on them. The drag part is first fitted, as shown on Fig. 12, with these dowel plates let in flush with the joint, those with the hole through being secured to the flask. The dowel plates are now placed on these and the drag placed on the plate. The two dowels on the dowel plate indent the wooden plate so that they can be let into the plate and insure their entering the holes on the drag part. Referring to Fig. 10 (A), it was mentioned that both the drag and cope were to fall in the same line Y X Y. There is no difficulty with the drag, because through the points X X of the flask a line is drawn, which becomes the Y X Y upon which the cope must drop. So it will be an advantage to have some form of adjustment on the cope part, as it will be difficult to fix the dowel plates sufficiently accurately, and also because if the patterns are found on the trial castings to be out of truth, the flask can be moved slightly to remedy the error. A simple method is to take a piece of angle plate B, as show in Fig. 13, and secure it to the side of the flask to which a plate A is bolted by countersunk bolts, this plate A having a hole to fit the dowels used, and a certain amount of movement, say, $\frac{1}{8}$ in., in the bolt holes. The dowels E are now inserted, and the cope part placed on the plate so that the X X drops as close as possible on the Y X Y line, the two dowels on the dowel plate locating their position on the plate. These are sunk flush with the plate, and the cope part is again placed in position to see that it accurately rests upon the Y X Y line. If any error is observed it is easily remedied by the adjustment of the plates previously mentioned. This arrangement makes a cheap and ready method for plates worked on a machine. If it be required to operate the pattern plates by hand it will be necessary to use the pins and ears on the flask to cover the lift on the depth of the pattern, so that fittings have to be secured to the plates to allow for the interchanging of the drag and cope in their position in regard to the patterns. In Fig. 14 one form of attachment is shown that will practically hold as true as an iron plate, the wood plate, when worn, being easily removed and substituted by another. A plan of the underside of theboard is shown, together with an elevation of the pin and socket bars; a study of these sketches leaves little for comment. The pin bar B is made a fixture and secured firmly to the board. The socket bar A has provision in the battens for $\frac{1}{8}$-in. adjustment in all directions, the bolts C being used to secure the bar to the plate when set. A means of fine adjustment is provided by the square nut E, engaging with the right- and left-hand shackles F. These are very essential, in case the trial set of castings be found overshot, for adjusting the cope part in order to rectify the order, and also to assist in strengthening the two bars. These may be made in malleable iron or brass. The principle of working wooden plates being understood, it is only a matter for experience to suggest a further extended use and application for these plates.

The Influence of Ingot-Size on Segregation.*

By Henry M. Howe.

The natural effect of large size should be to increase segregation. The author has previously pointed to the excessive segregation in many large ingots as tending to confirm this, but he has shown that in case of ingots less than 16 in. square this expected effect of ingot-size is liable to be masked by that of other variables. Under these conditions we should expect that if large ingot-size really does tend to increase segregation, this effect would be shown by taking the average of large numbers of cases, so that the effects of these other variables might off-set and cancel each other.

That the degree of enrichment does increase with ingot-size when thus studied is shown by Fig. 1,

* From the "Transactions" of the American Institute of Mining Engineers.

which represents the average degree of enrichment in 49 different ingots, divided into five classes, according to their size. This figure also brings out prominently the fact that the enrichment in sulphur is greater than that in phosphorus, and that in phosphorus greater than that in carbon. The detailed data on which this figure is based the author hopes to publish soon.

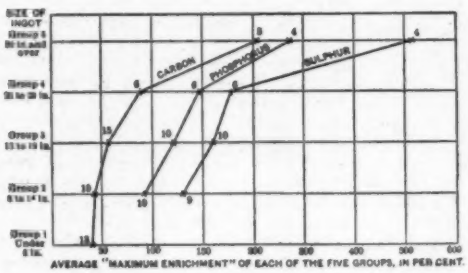


FIG. 1.—DIAGRAM SHOWING INFLUENCE OF INGOT-SIZE ON MAXIMUM ENRICHMENT IN STEEL INGOTS.

NOTE.—The "maximum enrichment" of each ingot, *i.e.*, the excess of the richest spot over the average of the whole ingot, is first calculated in percentage of that average. The average of the maximum enrichment of the several ingots of a given group is the abscissæ in Fig. 1. The number beside each spot tells the number of cases which that spot represents.

This figure further tends to show that the effect of ingot-size is relatively slight until the thickness of the ingot reaches something like 20 in., but that with further increase of size the enrichment increases more rapidly. This diagram is based on the enrichment at the richest point found in each ingot.

at its widest part and about 5 in. long. It is not necessary to discuss here whether this is a true case of axial segregation or not. The author's present purpose is to put this interesting case on record. Fig. 3 shows that some of the metal had been enriched in carbon so much as to have turned into white cast iron, with somewhere about 3 per cent.

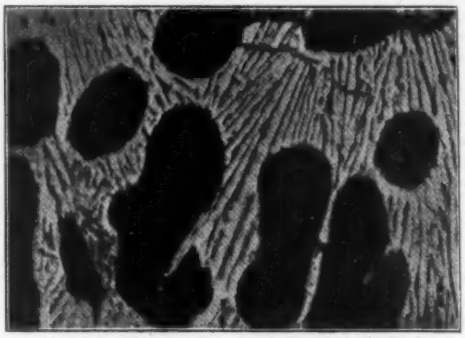


FIG. 2.—CROSS SECTION THROUGH SMALL CENTRAL CAVITY OF SMALL TEST INGOT.

(MAGNIFICATION ABOUT 800 DIAMETERS.)

A. Austenite cementite or white cast-iron eutectic.
B. Primary austenite.

of carbon. Indeed, the eutectic areas must contain more than 4.3 per cent. of carbon.

The ingot itself is a little acid open-hearth test ingot, which, after it had sunk to a moderate red heat, was quenched in water as a matter of convenience. Hence the martensitic structure. The

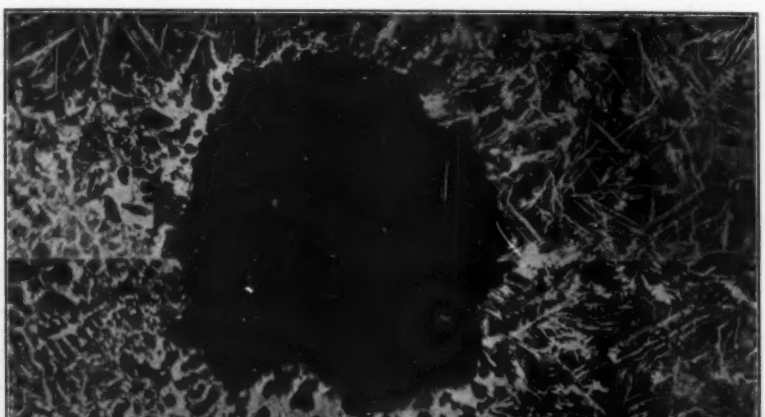


FIG. 2.—CROSS-SECTION THROUGH SMALL CENTRAL CAVITY OF SMALL TEST INGOT.
(MAGNIFIED ABOUT 130 DIAMETERS.)

That even very small ingots may be greatly enriched by segregation is shown by Figs. 2 and 3, which represent the microstructure of the neighbourhood of a small cavity in the upper part of the axis of a small test ingot, only about in. (or 0.94 in.) wide

metal from the outer part of this ingot contained 1.08 per cent. of carbon by combustion, as determined by Mr. J. O. Handy, of the Pittsburg Testing Laboratory, so that the enrichment even in this minute ingot is not far from fourfold.

The Scope of Science in the Foundry.*

By Richard Mather, B.Met.

This paper will not attempt to deal directly with the controversy which sets up "practice" and "theory" as two distinct and irreconcilable aspects of foundry control, and then maintains that salvation lies only with their particular favourite. Such a division is quite artificial and quite foolish; I have no particular concern to support either side. What I wish to do is to give straightforward information rather than personal opinions on this or that vexed question. I want to show just where scientific methods, or the knowledge and habits that come from a scientific training, can be applied in dealing with the affairs of the foundry. I don't pretend that all the troubles and ailments of every foundry in the land could be set right, here and now, merely by giving trained men a free and unfettered hand; but what I want to advocate, is the use in all foundries, and to the fullest extent possible, of such scientific methods and processes as are applicable and suitable to the work in hand. Naturally, a foundry with only a small output of castings, would not justify the employment of, say, a chemist or metallurgist exclusively for its own purposes, and I by no means suggest that this is in every case advisable, for the metallurgist has no monopoly of scientific instinct and logical method. There are men whose whole experience has been gathered in actual practice in the foundry itself, and who have never set foot inside a laboratory, who yet, by using their own powers of observation and reasoning, and by reading and studying books and papers on foundry matters, have brought their practice to great efficiency, and their knowledge to a high level; on such men the small foundry will still depend. Nevertheless these men are among the first to admit that they are handicapped by their lack of exact scientific training, and by their inability to carry out analyses, etc., and to profit fully by the more abstract and recondite papers given before the technical societies. It therefore follows that where the required quality of the work makes it desirable to have more careful and exact control of the materials used than is otherwise available, and where its output is large enough to justify the expenditure, it is wiser to employ a man who has been specially trained for that purpose, either in a technical college or a works laboratory, and who can apply and take full advantage of all the resources and methods, both old and new, with which scientific progress furnishes us.

While it is of prime importance that whoever has the responsibility for this section of the foundry duties, should thoroughly understand the full meaning and possibilities of all the analyses which may be made, it is equally important that he should understand also the processes in which the materials are to be used, so as to know just how and where to take full advantage of them; and if this duty be put upon the chemist or metallurgist, he should be in regular daily contact with everything in the foundry which his responsibility covers.

Before I pass to the detailed account of the work in which science finds scope, there is just one other question I wish to call attention to; it is the classification of wasters. I believe your President, in his address at the last meeting, emphasised the importance of careful and correct costing in the foundry, and, incidentally, this is as much a field for scientific and organised method as, say, the mixing of irons is. But while this is now getting some attention, I am not sure whether the importance of keeping an accurate and suitably classified record of wasters is duly realised. It would surely be possible in most foundries to enter up against the number of a certain product cast, the number which are bad owing to faults in the metal, to faults in the preparation of the mould, to bad blacking, to faults in the material of the mould, and so on. I know that it is not always possible to draw hard and fast lines between these groups in every case, but I fancy that most foundries could draw up a scheme of classification on these lines which would enable them to tell with tolerable accuracy, how the quantity of wasters due to any given type of fault, at any one period, compared with the similar figures for a different period. These figures could be of much more use than those got by lumping together all the bad castings and reporting them as so many per cent. of the total made.

Turning now from these general considerations to the more detailed treatment of our subject, we naturally put the metal itself as the first object of our attention. The analysis of the iron to be used in making castings is certainly the most common, and, I believe, the most obvious to the uses of science in the foundry. The foundry world was at one time divided chiefly between those who considered analysis to be a useless and often foolish superfluity, and those who placed an implicit and unwavering faith in it. But now that there is a more widespread knowledge and a more thorough experience of it, these two extremities of opinion have largely disappeared, so that, while there are few who deny that it has at any rate some utility, there are also comparatively few who regard chemical analysis as the one and only thing needful for perfection in the foundry. As an outcome of these more mellow and rational opinions, the number of chemists in iron foundries has steadily grown, and their chief work, as I have indicated, has been the analysis of the metal used and produced in the foundry, so that now I hardly need to dwell on the utility of analysis.

If we deal with the ingoing metal first, we find that of the two main sections, pig-iron and scrap, into which it falls, the former generally receives and needs the more attention. But the amount of attention it receives at the hands of the chemist is an enormously varying quantity in different foundries and for different classes of work. This is as it should be, and the precise details of the method of analytical control should be determined by the conditions in each foundry. In a foundry doing very important work, and dependent on outside and unreliable sources for its pig, it is certainly advisable, where possible, to have all the iron used analysed. It is only thus that one can avoid or nullify to the fullest possible extent the variations in the quality of the pig which so frequently occur, and which would have such serious results on work of the highest grade.

At the other extreme we have the numerous large foundries in different parts of the country which specialise in some one particular kind of product, such as pipes, chains, tanks, stove-plate, and hollow ware; these usually confine their supply of iron to one particular brand, and, indeed, chiefly to the one particular grade of that brand which is found to suit their work best; in many cases they are in more or less close touch with the furnaces at which the pig is made.

* Read before the Sheffield Branch of the British Foundrymen's Association.

At such foundries the demand made upon the quality of the iron does not approach so nearly to the limit of what is technically possible as in foundries engaged in, say, high-class marine or engine work; the allowable margin of variation is not so narrow, and, moreover, owing to the comparatively low prices of the products, the cost of full and complete analyses of every truck of iron used would become an appreciable factor in the cost of the castings. In such cases then, it is hardly practicable, or indeed necessary, for the scheme of analysis to be so thorough, and in the majority of cases it is customary to make only such analysis as will keep one reasonably assured, in conjunction with the ordinary inspection and other methods of testing pig-iron, that the deliveries are maintained at the required quality. This will usually amount to the analysis of samples from one or two trucks in each day's supply, which is generally sufficient, combined with a discriminating examination of the fracture and strength of the pig, to give a satisfactory indication whether a constant quality is being preserved or not.

Between these two extremes of the foundries making constantly varying castings of the very highest grade and those depending chiefly on repetition work in large quantities, and of medium quality, we have almost innumerable gradations, and the positions of these different classes in regard to the extent to which analysis should be and is applied in controlling the quality of the iron, vary according to the quality of the work, the quantity of it, and the source of supply of the pig-iron.

As regards the number of elements which need to be estimated by analysis to give a correct indication of the quality and usefulness of pig-iron of any particular brand, we find that of at least six which are always present, there are two which must always be estimated, two whose estimation is frequently advisable and useful, and two which, where the brand of the iron is known, for most purposes need only occasional checking. The estimation of Si and S is the irreducible minimum in the analysis of a pig-iron. However familiar one may be with the brands and even the specific grade one is in the habit of using, no analysis can be of much value which does not show both Si and S. Both are equally liable to vary, and the possible variation of the one is of almost equal importance with the possible variation of the other. These variations are wide enough to have a profound influence on the quality of the pig-iron. So that while the grade of the iron (as determined by fracture) follows the S with, perhaps, a little more fidelity than it does the Si, yet the aberrations from the normal are so frequent, and may be so wide, that any analysis should show both of these elements.

The two elements which it is advisable to estimate are graphite and combined carbon. Carbon in either or both of these forms is practically the essential constituent of cast-iron, and it is very largely by the influence on the quality and form of the carbon that we decide whether the presence of the other elements is good or bad for the particular object in hand. That an increase of Si tends to lower the total C, and to precipitate it in the form of Gr, while Mn and S have a contrary effect, is probably known to most of you already, and to expand on this point is unnecessary at this moment. Before one can afford to omit the estimation of these two elements, one must make oneself familiar with the brand and grade of pig-iron, find out how much total C it usually contains, whether it is very variable, and if so to what extent and how far the variation depends upon or can be deduced from the Si or S; and one must get an adequate idea of the extent of the change in the proportion of Gr to CC, caused by a given change in any of the other elements present. Of course, complications are introduced occasionally by different conditions of cooling on the pig beds, and in exceptional cases there are abnormal contents of Gr or CC, which cannot yet be satisfactorily explained. But, these apart, the Gr and CC can usually be gathered from a study of the fracture and a knowledge of the Si and S, with, where possible, the addition of the total carbon.

The two remaining elements, Mn and P, do not usually differ sufficiently in one grade of a known brand of iron to require regular and constant determinations. For instance, there is little fear of the P in different deliveries of the same sort of, say, hematite from a reputable maker, varying enough to cause trouble when the iron is used in the foundry, unless it be for very exceptional work, so that it is usually found sufficient if estimations of these two elements are made as a check from time to time.

The applicability of the above principles to special cases, such as ferro-alloys, will, I hope, be sufficiently evident. For example, there is obviously room for erratic results from the use of a presumably 35 per cent. Fe Si which even the dealers' will guarantee only to be within 5 per cent., *i.e.*, it may be anywhere between 30 per cent. and 40 per cent. Owing to the wide variation in the composition of ordinary commercial alloys, a knowledge of the actual, as distinct from the presumed, content of the special element, be it Si, Mn, or any other, is evidently important.

As regards scrap, it may for our purpose be conveniently considered to be of two kinds; that produced in the foundry, and that coming from outside. There should be little difficulty in dealing with the former; its composition and quality will be substantially the same as those of the castings in whose production it is made, and if the control of the quality of the castings is at all effective, the scrap should be a regular and satisfactory material to use. It should, of course, not be overlooked that in gates, risers, and the top parts of castings generally, the sulphur tends to be higher than the average for the whole casting to an extent dependent chiefly on the amount of Mn present and the slowness of the cooling. The treatment of outside scrap is another matter. Unless it comes from a known and assured source, scrap brought into the foundry from outside is apt to prove almost the most unreliable of all the materials used, and it should be watched as carefully as the pig-iron. The methods I have described for pig will be found generally suitable for scrap, but the difficulty of sampling will be greater in many cases, and the analyses should be used in conjunction with a thorough inspection of the general appearance and fractures of the scrap.

We must bear in mind that iron does not pass through the cupola entirely unchanged, and, although the chief functions of the cupola are to melt and mix rather than to alter the composition and quality, we find there are almost always changes in three elements: Si and Mn are lowered, and S is raised. In this matter again, there are exceptions and modifications of this briefly stated rule. The extent of these changes depend upon many factors. For instance, the loss of Si and Mn is greater according as the original quantity of these elements and the pressure of the blast are greater, and as the cupola is smaller, while the increase in S is greater according as the S in the coke is higher, and the Mn in the iron is lower. The Si may decrease by 0.1 per cent—0.5 per cent in ordinary practice, and the Mn by nil—0.3 per cent; the sulphur may, with very good coke and fairly high Mn in the iron, show no increase, but it normally rises about 0.02 per cent., and the increase with a bad coke may reach 0.05 per cent. or more. The exact degree of these changes, however, cannot be prescribed by an outsider, but should be determined by each foundryman for his own materials and conditions.

From this it will be evident that what we must aim at in mixing irons, is a composition which after allow-

ing for these alterations, will give us what we require in the casting. For example, if we want the casting to contain 2.0 per cent. Si and 0.08 per cent. S, we must start with a mixture containing, perhaps, 2.3 per cent. Si and 0.06 per cent. S. Now, knowing the compositions we want, and the compositions of the materials we have to work with, we must make our calculations accordingly. If we have only one or even two elements which vary, the calculation is simple and straightforward, but we have to fix three or four elements, and our pig-iron and scrap contain different proportions of each, considerable arithmetical facility is required if we are to be quite exact. But usually it is not difficult, after a short experience, to arrive at a suitable mixture fairly readily.

There is one aspect of analytical control of foundry-irons which may be noted here. Most foundries get into the way of using always the same sort of pig-irons for the same sort of work, and this is a good enough thing in its way, but there are apt to come times when it would be a decided advantage either on account of price or for some other reason, to replace some of the regular brands by fresh kinds of iron. Now, if the irons are mixed without any regard to or knowledge of their composition, and the man responsible has had little or no previous experience with the new brand of iron suggested, he is inclined to resist its introduction; and quite naturally, for it is largely a leap in the dark for him, and where the class of work done is important, experiments are expensive as well as being often inconclusive; but a knowledge of the compositions of the iron required and of the iron suggested, would, combined with a reasonable judgment, enable one to say whether the change was feasible or not, and to make any preliminary experiments with a better discretion and method, and to accept their results with more assurance.

We have now seen in what way and to what extent it is possible to make beneficial use of scientific methods in selecting and mixing the iron as it goes into the cupola, but I think we shall find that we have not yet quite exhausted their scope, even in regard to the metal. Of course, if the castings turn out successful and fulfil all the demands made upon them and satisfy the customers, all well and good, no further analysis need be made. But this does not always happen, even in the best regulated foundries; those thorns in the flesh known as wasters are occasionally produced, and it is the business of a good foundryman to find out the cause of them, and, where possible, to remove it. Sometimes there is no difficulty in this; the cause is obvious, and no special investigation is necessary. But often it is not possible to decide merely by an inspection of the casting which of two or more possible causes was responsible for making it a waster, or even to lay the finger on any cause at all. At such times an analysis of the metal in the casting is generally useful, and helps to clear away some, at any rate, of the uncertainty, although of course there are cases where one is left as much in the dark as before, and has to fall back on general reasoning and suppositions. The case of drawn castings illustrates this possible uncertainty as to the origin of the trouble; they may be attributable to faulty design, or uneven and improper cooling, or to the use of unsuitable metal, and often there is little to indicate which of these three is responsible. An analysis of the metal will usually show whether or not the blame should be laid on it.

So far I have occupied myself chiefly with chemical analysis as a means of testing and controlling the quality of iron. But this, of course, is not the only sort of test in use; these chemical tests are growing and gradually becoming more common, but it will be long before they are as widespread and generally used as the physical tests made on test bars, tensile and transverse. These physical tests are more readily made, and the results are more easily understood by anybody and everybody than chemical analysis. But yet, in spite of the fact that there are thousands of test-bars made and broken every day, the amount of reliance placed upon the results by foundrymen is very small. Certainly there are so many variable factors, most of which cannot easily be controlled with exactitude, influencing the loads test-bars will stand, that one is naturally slow to attach any very great importance to them. But, nevertheless, they have their uses, and for want of a readier and more reliable physical test, we must make the best of them. The size of the bar, the position and rate of casting, the temperature of the metal, the condition, the rate of cooling, etc., all affect the strength of the bar in addition to the quality of the metal. What we must do is to decide what size of bar, position of casting, and so on, we think will suit us best, and then stick to these and keep all the disturbing influences as constant and regular as possible. These well-confirmed results should bear, at any rate, some valid comparison with each other. But—and I am speaking now of transverse bars—before the figures obtained at the testing machine are tabulated and compared, there is one important thing to be done which is singularly often ignored or overlooked. This is to measure the bar to see if it actually has the size it is presumed to have. Unless the bars are made with extreme care from very good patterns, it will be found almost always that the size is not exactly what it ought to be. Many people are aware, in a vague sort of way, that the size of the bar affects the load it will stand, but they don't trouble or are not able to go any further. Of course, the most desirable thing is to have a bar of accurate size; but even the best of moulders cannot be guaranteed to produce bars correct to within say $\frac{1}{50}$ in. with regularity; and when it is realised that a difference of only $\frac{1}{10}$ in. in each dimension of a 2 in. × 1 in. bar makes a difference of over 1 cwt. in a bar which should stand 28 cwts., the influence of ordinary variations of size, amounting as they do to $\frac{1}{10}$ in. or more in extreme cases, will be appreciated. For example, in a paper on cast-iron which I once heard read, the author had, for some reason, given the sizes of the test-bars as well as the loads they stood, although he had not corrected his loads; in one case his bar was more than $\frac{1}{8}$ in. too small each way, with the result that a load, which should have been nearly 33 cwts., was reported as 25, the difference being $7\frac{3}{4}$ cwts. Yet the author of that paper had based conclusions of some importance on results of this kind; and I fancy there are many other foundrymen who base decisions on equally unsatisfactory foundations. Since it is evidently not possible to ensure getting perfectly accurate sized test-bars constantly, it is important that the bars should be measured and then the necessary calculation made to correct the observed load for the actual size of the bar. The formula expressing the relation between the load and the size of the bar is $W = C\,\frac{bd^2}{l}$. To start afresh every time and work the true load down from this equation, would be rather tedious, and it somewhat simplifies matters to put it in the form to which it can be reduced in the case of 2 in. × 1 in. bars; it thus becomes $W = W_1 = \frac{4}{b1.d1.^2}$ (where w_1, b_1, and d_1, are the actual weight, breadth, and depth of the bar). The bar can be readily measured by sliding callipers, and it is usually more convenient to work out the results when the measurements are made in $\frac{1}{100}$ lbs. and stated in decimals, although it is, of course, equally possible to use $\frac{1}{64}$ lbs. and $\frac{1}{32}$ nds.

As a rough and ready rule, it may be stated that for a 25-cwt. bar, each difference of $\frac{1}{100}$ in. in either dimension means a difference of $\frac{1}{4}$ cwt. in the load, or

for a 30-cwt. bar, each difference of $\frac{1}{32}$ in. in either dimension means a difference of 1 cwt. in the load; these figures apply, of course, only to 2 in. × 1 in. bars; the greater the load the bar stands, the greater the effect of a variation in size.

But the load is not the only thing required in test-bars; specifications frequently demand a certain minimum deflection at the breaking load or some stated load, and a knowledge of the deflection is often instructive in experiments carried out in the foundry. So now we are faced by the question of how the deflection is affected by the size of the bar. All the text-books and papers on foundry practice I have seen are silent on this point, so we have to start with the general and somewhat formidable equation which is applicable to all materials, that the deflection $D = \frac{1}{4}\frac{Mgl^3}{bd^3Y}$, where Mg = the load, and Y = Young's modulus. Fortunately for us, Young's modulus for cast-iron is constant for all loads up to the breaking load, so that the equation is directly applicable as it stands, but it is too cumbersome in this form for regular everyday use, and is complicated by the fact that before we can apply it we must also calculate the corrected load. But if we work it down we find that, for a 2 in. × 1 in. bar, it simplifies itself beautifully, until we have the straightforward expression $D = D_1\frac{d}{2}$, D_1 being the observed deflection at the actual breaking load, and thus we find that the true deflection is independent of variations of breadth, and is equal to the observed deflection × the actual depth ÷ 2. This means that for every $\frac{1}{10}$ in. the bar is too deep, the observed deflection is to be increased by 1 per cent. to give the true deflection. This question of the size of test-bars is, I believe, rather widely neglected; attention to it would probably do away with some, although admittedly not all, of the discrepancies in results which otherwise seem so inexplicable.

The other mechanical and physical tests which are made on cast-iron call for little detailed comment. Perhaps the tensile test comes next to the transverse in frequency, but it makes a poor second. There is a certain amount of controversy as to whether they should be cast vertically or longitudinally, but until this matter, and the size of the bar, and the amount of machining to be done on it are standardised by some authoritative body, the chief point for individuals to observe is that all their own tests are made on bars cast and treated in the same way so that the results may be truly comparable.

The extent of the total contraction of the iron is a quantity which is fairly often measured, particularly in high-class work, where, for reasons of strength, the combined carbon in the iron is often high enough to make the contraction an appreciable quantity, and one liable to have important effects on the casting if not properly controlled. The measurement can be made on an ordinary bar by measuring the length of the pattern and subtracting from it the length of the bar cast from it.

One important feature about all these tests, both chemical and physical, is that they should be made in such a way as to show exactly what they are intended to show, and nothing else. One cannot take too great care in excluding variations other than those intended and reported. There is a tendency among some people when investigating one point, to do it in such a way that, quite unconsciously, they permit their results to be made useless by some other variation which is not noted, measured, or allowed for. A good grasp of scientific method and clear reasoning is very necessary in planning any series of experiments, in reporting them, and in interpreting the results, and recognising the limits within which alone they are applicable. Superficial and uncriticised results are often misleading. Turning now to some of the other materials used in the foundry where scientific methods may help in procuring or maintaining good quality, the material which of all others has the most intricate effect on the iron is the cupola coke, and its influence is manifested chiefly in the transference of some of the sulphur of the coke to the iron melted in contact with it. The more S there is in the coke, the more passes into the iron, and, consequentlly, it is important that there should not be sudden fluctuations and excessive quantities of S in the coke. To make quite certain of this, analysis is necessary, for there is no adequate way of telling how much S there is in a coke by looking at it, or by testing it in any other way than by analysis. The usually accepted figure for S in a good foundry coke is 1 per cent. as a maximum; and if the S does not exceed this there is usually no need to fear serious results for ordinary work, although, of course, the purer the coke the better. I believe there are rare cases where foundries have specified that, in addition to low S, the coke should have low P also, but except for very bad coke or very exceptional work, this is an unnecessary refinement. The ash-content in coke is a matter to which it is advisable to have some regard. It is customary to consider 10 per cent. of ash as an acceptable quantity, and where this figure is not exceeded, there is seldom any cause for complaint with regard to the ash, but when it is over 10 per cent., the ash is apt, in addition to decreasing the number of heat units available, to cause an unnecessary quantity of slag, and where the ash is not self-fluxing, to require extra limestone to make the slag run freely. Within ordinary limits, the lower the ash the better, although, if it were very low, the coke would be rather weak; but there is little likelihood of such coke being obtainable nowadays, so one may thankfully take the coke with the lowest ash available, other things being equal.

There is one other matter in the melting process in the cupola, besides the quality of the iron and the coke, which should be watched. This is the blast-pressure. Of course, where the blowing equipment does not permit of varying pressure, this question does not arise, but where the pressure may and does vary from time to time, its influence is worth investigating, as an increased pressure, by increasing the oxidation (to a variable extent under different conditions) can cause a more or less appreciable change in the quality of iron tapped from the cupola, while the quality of the iron charged into the cupola remains constant. For this purpose a pressure-gauge on the blast-main or on the blast-box of the cupola is indispensable, and a continuous recorder is of considerably more use, for a study in the variations of blast pressure would probably throw an interesting light on the changes in the iron coming from the cupola, and should certainly lead to a more thorough understanding of its work.

If we turn now from the metal to the mould in which it is to be cast, we find other materials awaiting attention, and again scientific methods can be of use, although, perhaps, hardly to the same extent as with the iron. The sand and loam used in the mould are apt to vary in quality just as all natural products are, and it is important that these variations should be minimised. The ordinary foundryman can detect these variations and make suitable allowance for them more readily than he can for variations in the quality of the iron; his usual test of squeezing a handful of sand will give a pretty good idea of its bonding quality, so that analysis, which if it is to be done fully is a fairly long process in this case, is not often resorted to, although it is possible to get a fairly reliable idea of the amount of clay-matter present by merely determining the percentage of combined water. Where analysis is more useful, and, in fact, necessary, is in determining those constituents, chiefly lime and iron oxide, which render a

sand fusible, and when the sand is variable, regular estimations of these are useful in helping to avoid trouble on this score.

But, perhaps, the chief way in which scientific and exact methods can be of advantage in dealing with moulding sands, is the control of the fineness, *i.e.*, the size of the particles of the sand. There is room for considerable variation here in a point which affects closely the utility of the sand, and whenever the sand or loam lends itself to the process, the fineness should be systematically and regularly determined, and the sand classified accordingly. The operation is comparatively simple, and consists in passing a known weight of the sand through a series of sieves of different meshes, and weighing the portion which passes through each, rising the figures so obtained to express the degree of fineness. C. Scott, in the "Iron Age," a few years ago, described, among a series of very interesting foundry specifications, a well-thought out and simple method of standardising this determination of fineness, and expressing the results in figures, which he uses in drawing up specifications when purchasing sand. He classifies the sand in five grades, that at one extreme, superfine, having 100 degrees of fineness, and that at the other, extra coarse, having 55-30 degrees of fineness. Unfortunately, there are some kinds of sand and loam to which this method is not applicable, owing to the way in which the particles, though very fine, cake together; but in most cases this determination of the degree of fineness would be found very interesting and useful.

Another of the materials used in the mould is the facing, usually a blacking. Blacking consists generally of two or more of the following, mixed and ground together:—Charcoal, gas-carbon, plumbago, and clay, and occasionally coal. In every case it is carbon in one of the three forms given above, which is the essential constituent. The clay is used chiefly as a vehicle for the other constituents, and to help them to mix more readily with the clay-wash when the facing is applied wet. Since it is carbon which is required, a useful check on the quality of the blacking can be obtained by determining by analysis the percentage of C and ash. Where this analysis is for any reason impossible, a variation in the proportion of C to ash may be detected by determining the specific gravity of the blacking, for which purpose nothing but a specific gravity bottle and a balance are required; an increase of ash will cause an increase of the specific gravity. Here again, in the case of blacking, a determination of the fineness may occasionally be useful, but this is not often necessary, since most makers grind their blacking so as to pass entirely through a 100-mesh sieve.

Coal-dust, too, is a constituent of some moulds which is subject to a certain amount of variation, and although a poor coal-dust is not usually responsible for such serious results as can be brought about by a bad blacking, yet it is as well to see that its quality is kept good. The percentage of volatile matter should be satisfactory, and care should be taken that the moisture and ash do not exceed reasonable limits, say 5 per cent. to 10 per cent. respectively; a coal dust containing 8 per cent. moisture, and 24 per cent. ash should be rejected.

I don't propose now to enter into any of the other matters where a knowledge of scientific principles can usefully be applied. I have covered, perhaps, the general field, which is common to all foundries; and as to the special questions and processes which are confined to a few, such for instance as the use of coal and producer gas, the above general outline of methods and principles should be sufficient to indicate the possibilities, tendencies, and methods of scientific control.

In conclusion, I fancy that to some this paper may have seemed somewhat too full of qualifications and compromises, and not to have expressed hard and fast opinions definitely enough, or given sharply-drawn, clear, black and white accounts, and outlines. If this is so, it must be ascribed to a desire not so much to state a case immoderately and defend it, as to realise and explain what I think to be the scope of science in the iron-foundry and what its capabilities and limitations are.

A Sand-Blasting Helmet.

It is essential that the operator of sand-blasting apparatus for cleaning and removing scale, dirt, etc., from castings in the foundry be well protected from the dust and grit in the air that inevitably accompanies the operation, unless, of course, the sand-blasting is carried on in a totally enclosed machine. Since such machines, however, are only constructed to handle small work, and since other larger work has to be cleaned either in the open or in a specially prepared room, provision must be made for the protection of the workers. In a properly constructed room for the purpose of cleaning castings, ventilation is provided to supply fresh air and carry off the dust, but even then some extra protection is desirable. We illustrate herewith a helmet which was designed for use with sand-blasting apparatus, and provides an efficient protection for the operator. The helmet is made of leather, with sheet rubber in front to preserve it from the rebounding sand. Pure air, for breathing and ventilation, is forced into the upper portion of the hat at about 1 cubic foot per minute. Fine wire gauze, celluloid film, or other transparent material, is attached to the helmet in front of the eyes. The vitiated air passes out through the loose portion of the hat.

The makers of the helmet are the Tilghman's Patent Sand Blast Company, Limited, of Broadheath, near

SAND-BLASTING HELMET.

Manchester, who specialise in all apparatus for sand-blasting.

D

Aluminium Welding.

Treating with this subject, a writer in "Electrochemical and Metallurgical Industry," refers to the method of Heraeus, who was the first to weld aluminium. His method is based on the fact that at a certain temperature (around 550 degrees C.) aluminium softens and that in this plastic condition it can be united or welded with a similarly heated piece with the aid of hammering. The fundamental principle is, therefore, the same as that of the very old iron-welding method with which every blacksmith is familiar. The characteristic feature of the method of Heraeus is the maintenance of an exact temperature. At too low a temperature no union is obtained, while at too high a temperature the aluminium gets brittle or softens and spatters away under the hammer.

To employ the correct "critical temperature," the writer continues, is purely a matter of experience and skill, and for this reason the use of the method involves difficulties, especially if sheets of less than 2.5 mm. (one-tenth of an inch) are to be welded, and aluminium alloys, like magnesium, partinium, etc., are to be welded. Articles welded according to this method were first exhibited in Paris, in 1900. As a matter of curiosity it may be mentioned that there exists a United States patent for a process which is identical with that of Heraeus. It is No. 710,958 of March 21, 1901, granted to M. Wisniewska, and claiming "the process of welding aluminium which consists in bringing the thoroughly cleansed parts of aluminium to be united into contact, and applying heat to the same until the metal begins to soften, whereby they may be welded or permanently united."

A patent for welding aluminium, which is not without a certain interest, is the German patent, No. 109,433 of 1899, which refers to a "process of welding aluminium and aluminium alloy with or without flux or reducing joints." At the moment of welding it is intended to tear or remove mechanically the oxide film formed during heating. It is recommended to use an electric current whereby one pole is connected to the articles to be welded and the other pole to a suitable carbon electrode. It is said that by this method the aluminium oxide is electrolytically decomposed and the welding process accelerated. The pressure applied is 6 to 8 volts.

The writer states he had tried to weld aluminium according to this patent, but has been unsuccessful, although familiar for many years with methods of welding iron and lead. Though the melting coil of lead in degrees Centigrade is just one-half that of aluminium (330 degrees for lead and 650 degrees for the aluminium, and the thermal conductivity of lead is less than that of aluminium, yet the current may rise to 50 or 60 amperes, when welding lead sheets of 2 mm. (80 mils) in thickness. If aluminium sheets can really be welded by this method, the current consumption will probably be so high that the process will hardly be commercially practical.

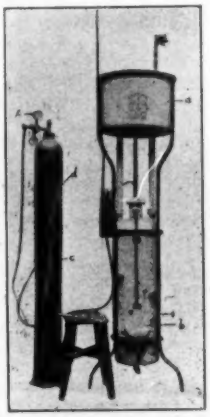
In several patents it is proposed to remove the oxide film formed on heating by mechanical means, by scraping with suitable instruments. If thick, solid articles are to be welded it is possible to break through the superficial oxide film with an instrument, and to cause in this way a union of the parts of aluminium. But with thin sheets this method cannot be used.

Of methods for soldering aluminium there exists an enormous number, but without discussing these in detail, I will say that most of the joints made by soldering aluminium will lose after a short time their original strength; and this is always the case if the solder contains tin. A quick method of determining the quality of an aluminium joint is to place the article into hot acidulated water, whereby the evolution of little hydrogen bubbles can be directly observed with the eye. This is due to local electrolytic action whereby the joint will be decomposed. This electrolytic action will progress rapidly, if in the galvanic metal series the foreign metal in the solder is removed from aluminium.

Applications of Aluminium Welding.

Aluminium has a high resistivity against most acids. According to Prometheus, the German army workshops have been using for the last three years aluminium vessels for working with acids, and the results have been very satisfactory. Nitric acid or sulphuric acid and their hot vapours attack aluminium only slightly, and after two years of use the vessels could still be satisfactorily used.

The Aktien Gesellschaft für Aluminiumschweissung, in Zurich, has carried out a long series of tests in



Apparatus for Aluminium Welding.

order to determine the attack of aluminium by acids, especially by nitric acid. The results may be briefly summed up by stating that the attack of aluminium by nitric acid is greatest for an acid concentration of 30 per cent., and this attack will go on the more rapidly the greater the impurity of aluminium, other things being equal. With lead the situation is similar.

Of the different kinds of aluminium made in Europe, the English metal was found to be the best, and was least attacked by acids. As an example may be mentioned comparative tests made with 100 per cent. acetic acid which showed a loss of weight per 100 sq. cm. surface of 1.66 mg. for English sheet aluminium, and 5.77 mg. for Swiss sheet aluminium. A typical analysis of English sheet aluminium is 0.312 per cent. silicon, 0.256 per cent. iron, 0.096 per cent. tin, hence total impurities 0.644 per cent., so that aluminium is 99.34 per cent. pure.

It is certain that not only the chemical composition, but also the structure and the condition of the surface of the sheet aluminium are of importance with respect to the attack by acids.

Take three-hard-rolled sheets of aluminium of equal size, of which I is carefully polished, II has a frosted surface, while III is heated over a Bunsen burner, until a chip of wood begins to char. These three sheets of aluminium will behave very differently in an acid bath. Number I will be attacked least, and number III most. Number III will be very similar to cast aluminium, and with a lower specific weight and a more crystalline structure than the rolled and hard material of I and II.

Burners for Welding.

Concerning the most suitable type of burner and the most suitable gaseous fuel, there may be a difference of opinion. For thick aluminium sheets it is advisable to use the oxy-acetylene burner which permits the production of intensive local heat effect within a short time. Fig. 1 represents the apparatus of Michel-Molas, of Paris. The water is filled into *a*, the carbide into *b*, *c* is a steel container for compressed oxygen (125 atmospheres), *d* the burner and *e* the manometer.

For welding thin sheets, the oxyhydrogen blowpipe is sufficient, or the oxygen-illuminating gas blowpipe. The last one is especially useful in places where illuminating gas is available, as nothing more is required but a compressed oxygen container with a reducing valve, several feet of rubber pipe, and the blowpipe.

For welding iron sheets the composition of the illuminating gas (its contents of sulphur, phosphorus) has some influence on the result. On the other hand, at least according to the experience of the writer, the quality of the gas is of no importance for aluminium welding. But it is important that the two gases leave the burner as an intimate homogeneous mixture. This requirement almost contradicts the other practical requirement that, for the sake of safety, the two gases should mix only just before they leave the burner. Backlighting may be avoided if the speed with which the gas mixture flows out of the burner is greater than the speed of propagation of the explosion.

There is no special difficulty in the practical application of autogeneous aluminium welding. Especially men acquainted with lead burning, skilled in handling the burner and careful in observing the operation, will learn to weld aluminium within a few days. With some skill it is also possible to avoid the tensions within the material which easily may develop in the case of thick sheets or in repairs of thick pieces, like automobile motor cases.

The Vulkan Casting Drum.

The advantages claimed for the casting drum illustrated herewith, which has been introduced by the Vulkan, A. G., Cologne, are that it is easily handled without the least danger, prevents loss of heat by radiation, give clean castings, precludes the risk of accidents, and requires very small motive power—just sufficient to overcome the friction of the journals, so that no worm and pinion reducing gear is needed as for large casting ladles. The drum is lined with fireclay plates, which can be easily inserted after removing one end of the casing; and the life of the lining is longer than in casting ladles, owing to the pressure exerted all round by the casing. These drums are supplied either fitted with crane slings; fitted with slings and mounted on a truck so as to tilt for pouring; or fixed on a truck for use with hand ladles in foundries employing moulding machines. In the smaller sizes the tilting gear is operated by a double handle, as shown in the drawing, blocks and sheaves with a guide handle on the other end of the drum being used for the larger sizes (up to 25 tons capacity). The trucks are mounted on cast-steel wheels with ball roller bearings.

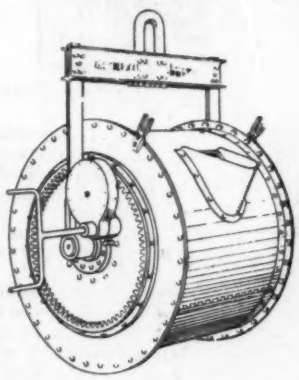


FIG. 1.

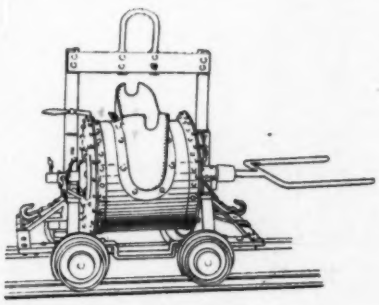


FIG. 2.

THE VULKAN CASTING DRUM.

Moulding and Pouring Cast-Iron Columns.

There was a time when every American and German specification concerning cast-iron columns, and most of those relating to cast-iron pipes, contained a clause to the effect that they should be poured in a vertical position. This, in face of the fact that the Glasgow founders—who could cast thinner, longer and better than anyone else, so that the name of Glasgow was like a red rag to a bull when mentioned to an American pipe-founder—all cast their pipes in a horizontal position. This vertical casting was sometimes very inconvenient in the old-fashioned foundries, as their crane facilities were both limited and primitive, and a 6-ft. hoist was often the maximum. It was supposed that the riser, or sinker, or dead head, as it was variously called, had the great advantage of receiving all the poor metal, while exerting a pressure on the fluid material in the lower portions of the mould. Nowadays, however, columns are as often as not cast in an inclined as in a vertical position; the angle varying between 30 and 45 degrees from the vertical, and they are even poured in horizontal moulds. Formerly, the flasks were in only one piece, corresponding to the length of the desired column; nowadays there are employed sectional flasks with flanged joints pieced together with bolts and nuts.

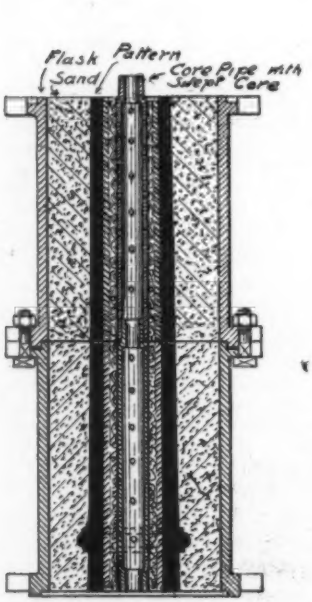


FIG. 1.

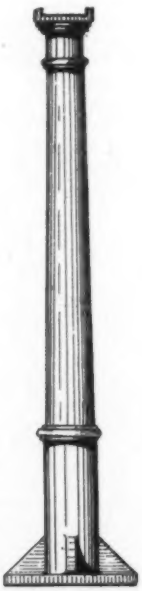


FIG. 2.

FIG 3.

Fig. 1 of the illustrations herewith, from "Eisen-Zeitung," shows a flask thus composed of united flanged sections. Each of the sections is rammed up independently, which has the advantage of insuring a much more uniform degree of compression of the sand. This has also the additional feature that more than one workman can ram the mould for each column. Of course, the head and foot flasks have diameters suitable to delivery of capitals and bases of the required size. The core is also made up of sections which are inserted in each other so as to

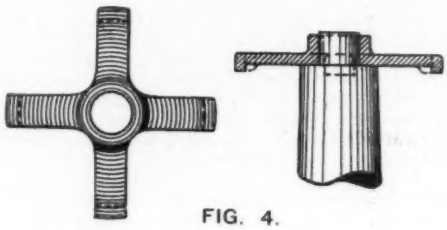


FIG. 4.

form practically a continuous whole; the lengths of the sections corresponding to those of the component parts of the flask. The pattern sections, which can be either of wood or of thin cast iron, are properly centred by means of accurately turned and placed dowels, that are removed after the ramming. The centrality of the work is ensured by spiders, shown in Fig. 4, and which are removed after the ramming is concluded. The core is held in the usual manner by prints.

This process permits also of moulding and pouring the so-called "show-window" columns, as seen in Figs. 5 to 7 inclusive.

FIG. 5

FIG. 6.

FIG. 7.

Manganese in Copper Alloys.

By A. Napier.

Manganese, which has become so prominent in recent years in the iron and steel industries, has also found an important place in the brass foundry. Manganese-bronze, or as it should perhaps strictly be termed, manganese-brass, finds so many applications in modern commerce that its properties, qualities, and peculiarities should be well understood by every brass founder. For it is an alloy that has many personal peculiarities, and which does not always appear amenable to persuasion by the founder who is not well acquainted with it.

Manganese is a substance of a whitish grey colour, of high metallic lustre, and with a specific gravity of 7.5. It is extremely hard, being sufficiently so to scratch glass. It is generally used in the foundry in the form of an alloy with copper, known as manganese-copper or cupro-manganese, about 70 per cent. copper and 30 per cent. manganese being the usual composition. This is used in the metal mixtures in sufficient quantities to give the necessary manganese content, varying according to the purpose to which the casting is to be put. Copper-manganese alloys are noted for their strength and ductility, and give good bearing and journal castings for use under some conditions, but what is perhaps one of the most important applications of manganese-bronze is the casting of steamships' propellers. It allows of these being made thinner than is the case with other metals, as the ductile properties of manganese-bronze render them less liable to sudden breakages, while a bent propeller blade of this alloy can also be straightened again. It is also less liable to corrosion than other copper alloys.

Since manganese is a metallic substance, it is by many users preferred to phosphorus, which is a non-metallic substance, for use in bronze castings. It is a more powerful deoxidising agent, and an excess of it does not damage the alloy. There is, however, one important particular in which it is inferior to phosphorus; with manganese the molten metal, as it is being poured, oxidises on the surface, and is liable to produce dirty castings unless considerable care is taken, whereas phosphor-bronze runs perfectly clear, as the phosphorus reduces the oxide which forms on the surface of the metal, giving very clean castings. In order to overcome the difficulty of oxidation, with alloys containing manganese the mould must generally be constructed with skim-gates to deal with the dirt, and other precautions must be taken, which points will be dealt with later on.

It is possible to use the pure metallic manganese instead of the manganese-copper alloy referred to above, but since the melting point of manganese is very high (considerably above that of copper) it cannot be added in the crucible in the same way as any of the other constituents of brass can, for it would float on the top and become skimmed off without melting. It would, therefore, have to be first alloyed with a portion of the copper, and this would involve overheating that amount of copper, in order to melt the manganese. Ferro-manganese, also, even though of a high Mn. content, is too often objectionable to the brass founder on account of the Fe. which would be introduced into the brass, though there are many cases where it can be, and is, used. The better way for the average foundryman is to purchase the manganese in the form of the manganese-copper alloy, cupro-manganese. This is obtainable commercially in ingots containing about 30 per cent. manganese and a small amount (generally less than 1 per. cent.) of iron. This amount of the latter metal in the cupro-manganese is not sufficient to have any material effect on the ultimate brass. The proportion of manganese-copper used to obtain the desired Mn. content in the metal is only small, ranging, according to the purpose for which it is required, from sufficient to give a trace to 6.0 per cent. Mn. The amount of the alloy must be calculated on its manganese contents, and, therefore, to obtain 1 per cent. Mn. in a final mixture of 100 lbs., about 3½ lbs. of 30 per cent. Mn. alloy must be used. The melting point of this alloy being comparatively high, it is not advisable to add it after the other metals have been melted, as the latter will have to be overheated in order to melt the manganese-copper. The better way is to weigh out the necessary amount of the alloy and place it in the crucible with the copper, melting them together under a covering of charcoal, and stirring thoroughly when melted to ensure proper mixing. As the Mn-Cu alloy is very hard, it is difficult to weigh the correct amount from the ingot, therefore it is advisable to melt it down and pour into strips or small pieces, which can then be broken or sheared up as found necessary. Having introduced the desired amount of manganese, the making and melting of the mixture proceeds in the usual way. If tin is being added to the mixture, it may be mentioned, the slip-shod method of marking the block and holding the end in the molten metal until the desired amount has been melted off is not to be recommended; a much better method is to cut off and weigh out the desired amount, even though this involves melting the block tin and running it into handy sizes for cutting up.

The foregoing instructions assume that the founder is making his own manganese-bronze or brass, either for pouring into ingots for re-melting, or for pouring at once; many founders, however, prefer to buy their ingot metal, as they have considerable trouble in getting successful results from ingots of their own make, owing to variation in the contents. When making one's own metal it is best to pour it into ingots and then re-melt it for the castings, as cleaner and better results are generally obtained by doing so, though care must be taken not to incur disproportionate losses of any of the constituents in the re-melting.

Pouring.

Pouring manganese-bronze at a high temperature is generally conceded to be disastrous for good work. The resulting structure will be coarse and crystalline, the castings will be dirty, and shrinkage troubles will also be more difficult to overcome. The name "manganese-bronze" is here somewhat misleading, as it tempts the founder to apply the same rules as for casting bronzes. But it must be borne in mind that there are several constituents in manganese-bronze and brass that are not contained in ordinary bronze or brass, and these give quite a different character to the metal. The necessity of avoiding pouring at too great a heat, however, should not lead one into the other extreme, or equally bad results will be obtained. Manganese-bronze poured at too low a

temperature is poor in structure, and weak, lacking the essential features and characteristics of a good casting of that metal. The pouring should be continuous and uninterrupted, in order to avoid cold shots and dirt, and the metal should be exposed as little as possible to the air. In order that the stream of molten metal shall not come into contact with the air, one writer advises the use of an ingenious device, which he claims to have used successfully. A ring of cotton waste, saturated with oil, is placed round the gate and ignited just previous to pouring the metal in. The flame, which is a reducing one and therefore protective, is allowed to envelop the entire stream of metal as it leaves the crucible or ladle, and it thus prevents contact with the air. There are many jobs on which the founder would perhaps think precautions such as this to be superfluous, but the method is well worth applying where good results are desired. In any case, the pot should be held as low as possible, and the metal poured rather slowly and in a somewhat small stream. Much will, of course, depend on the particular casting and the length of the runner, etc.

Gates and Risers.

The shrinkage of manganese-bronze is greater than ordinary brass or bronze mixtures, and this often leads to trouble, which can only be overcome by the proper use of risers. The chief factor to bear in mind is the necessity of supplying large gates that will keep fluid and feed the whole of the casting until it has finally set. Too often the comparatively small wedge-shaped risers that are familiar to the brass and bronze founder are tried, but without success. In the case of a heavy part that develops shrinkage or cracks, a riser of very large size supplying molten metal direct to the heavy part will generally overcome the trouble. The proper design and position of the risers is a matter for careful consideration, but when the main principle is understood, and the use of risers properly appreciated, a little common-sense and judgment will soon decide as to the manner of applying them to any particular casting. It is folly to attempt to cast manganese-bronze on the same lines as brass or ordinary bronze; it must be dealt with entirely on its own merits—and peculiarities. As indicated in connection with the pouring of the metal, the gating of the mould is important, as on it largely depends the cleanliness of the casting. The tendency of a long gate to collect the dross and prevent it entering the mould recommends it for manganese-bronze work, and in many cases a gate running the whole length of the flask is advised. The gating should preferably be done on the light part of the casting, the risers supplying the metal necessary to feed the heavy parts. In the case of small castings a long runner is generally sufficient to clear the metal of dross, but for larger work a skim gate is advisable. A horn gate is necessary where a long drop is given the metal, in order to avoid dirty castings, which generally result if the metal is stirred up in its journey to the mould.

Various Manganese Bronzes.

While cupro-manganese, as already stated, is the handiest form in which to apply manganese to brass-foundry purposes, there are a number of manganese bronzes or brasses made with ferro-manganese. In such cases the alloys often contain percentages of aluminium. A very strong, fine- and close-grained series of alloys is obtained by the addition of aluminium to manganese-copper alloys, but it is not the writer's intention of discussing them now. The copper-zinc alloys are the ones more particularly under consideration, though the foregoing instructions apply almost equally to those containing from small to considerable percentages of tin. As an example of such a mixture that gives good results for journal and similar castings may be quoted the following:—Cu 84.0, Zn 4.5, Sn 6.5, Mn 5.0 per cent.; while another, suitable for propellers, spur-wheels, etc., is given by one authority as Cu 54.0, Zn 40.0, Sn 2.25, and Mn 3.75 per cent.

These are only two examples of mixtures that have proved successful; a number of very different ones might be quoted, as, for instance:—Cu 82.0, Sn 8.0, Zn 5.0, Pb 3.0, Mn 2.0; and Cu 83.5, Sn 8.0, Zn 5.0, Pb 3.0, Mn 0.5, both of which are cited by Guillet as being employed for hydraulic machinery. As in the case of other alloys, the composition is governed by the use to which the casting is to be put, and also the fancy of the founder. But, in conclusion, it may be stated that the use of even a small percentage of manganese in brass or bronze mixtures assists materially in giving strong castings free from blow holes, and, providing it is handled properly, will prove of great value to the founder. But he must know how to deal with it or he will court disaster.

PRESENTATION TO MR. WILLIAM VICKERS.—Mr. William Vickers, who was one of the founders of the British Foundrymen's Association, and is a member of the Council of that body, has relinquished his post as head foundryman at the works of Belliss & Morcom, Limited, Birmingham, to become a foundry manager at the work of Siemens Bros., Limited, Stafford. On Friday evening, October 29, a farewell was taken of Mr. Vickers by his colleagues in Birmingham at a smoking concert, the company numbering about 120. The chair was taken by the foundry manager, Mr. F. J. Cook (President of the British Foundrymen's Association), the items of programme being, with one or two exceptions, furnished by Mr. Vickers' fellow-workmen. Mr. Cook proposed the health of Mr. and Mrs. Vickers, and remarked that as long as mutual confidence prevailed between the workmen and those in charge all would go smoothly in the foundry. Mr. Vickers, during the time he had been with them, had always required all under him to do their best, but he had also done the best he possibly could for them. They had done their duty, and would help to bring Messrs. Belliss & Morcom into the front rank of engineering firms. Mr. Vickers had always been honest and straightforward with them, and he hoped the regard Mr. Vickers had won would be shown by them towards those who would take his place, and who, he (the chairman) could safely say would act in the same spirit. The toast, "Good Health and Success to Mr. and Mrs. Vickers," having been proposed and drunk with great enthusiasm, Mr. Boden, one of the oldest hands in the foundry, asked Mr. Vickers to accept from the workpeople a marble timepiece as a mark of their esteem and respect. Mr. Vickers thanked the chairman and Mr. Boden for their kind words, and the company generally for their present, and expressed his appreciation of his fellow-workers' efficiency or for personal qualities. Mr. Vickers has also been the recipient of a handsome smoking cabinet from the members of the staff and a case of pipes from the foundry manager.

Chaplets.

By Ingenieur Hutmacher.*

Of late a number of different chaplets have been put on the market, with varying results in practice. The tinning of these chaplets is often carelessly done, the alloy used frequently containing upwards of 50 per cent. of lead. Naturally, the iron will not rest on supports of this kind, and welding is therefore impossible. It is therefore advisable to specify careful tinning and that a certain maximum percentage of lead should not be exceeded. The unpleasant consequences of imperfectly tinned chaplets are well known to every foundryman; defective castings (cylinders, etc.) that have to be scrapped on this account being of frequent occurrence. Open-sand casting needs fewer chaplets than weighting irons,

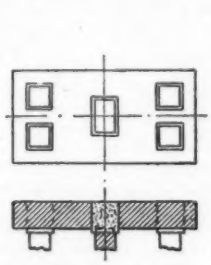


FIG. 1.

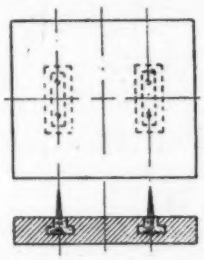


FIG. 2.

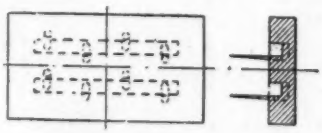


FIG. 3.

nails, and hooks. In most cases the necessary cores are made of the same material as the moulds, and are weighted down by means of pieces of iron or the like (Fig. 1). If the cores be of such a type as to require any special method of production and drying (Fig. 2), they are fixed in position by means of spikes or hooks (Fig. 3) when loading with iron is impracticable. The numerous forms of chaplets and double chaplets find their chief application in box casting. Those shown in Fig. 4 are preferably used in casting pillars and pipes, the piece of sheet metal riveted on being curved to the exact shape of the core. When pipes are to be produced to stand a given pressure and consequently have a compact structure, these core supports are attended with a certain drawback, the stem having to be knocked off with the hammer and chisel in the fettling shop, the result being that the chaplets, although roughened, become loosened in the wall of the pipe. If the only partially welded chaplets can be stemmed, this treatment may afford a remedy; otherwise it will be necessary to draw the stump out of the pipe, tap a thread in the metal, and screw in a nipple, which operation is a long and expensive job.

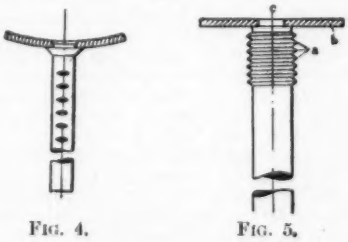


FIG. 4. FIG. 5.

* "Giesserei Zeitung."

FIG. 6. FIG. 7. FIG. 8.

The author makes these stays of cast iron of different thicknesses (Fig. 5), a method possessing several advantages. Made by the aid of a moulding machine these stems can be turned out 24-32 for a penny. The

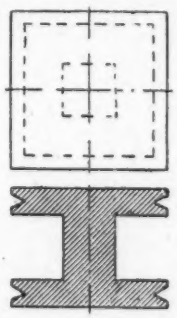


FIG. 9.

cast grooves *a* (Fig. 5) prevent any leakiness, but the grooves must be cleaned up bright with a file before the stay is used, so that the metal will unite better with the molten iron in the mould. A few light blows with the hammer on the head *c* of the stem, will be sufficient to fix the wrought iron plate *b* on to the stem. It is advisable to make the heads *c* on all stems of the same diameter, so that the wrought-iron plate can be prepared in large numbers and kept in stock. The diameter of the stem will depend on the thickness of metal in the casting for which it is used. Diameters of ½ to 1½ in. have always proved successful. By omitting the head *c* and the wrought plate *b*, these irons can be used for stiffening very heavy cores. At the place where the core is to be supported, an iron plate is put into

FIG. 10.

FIG. 11.

the core and used as a support for the core iron. The latter must be of suitable thickness, in order to bear powerful wedging, without breaking, when the mould is closed. As already stated, cast chaplets can always be successfully used when compact structure is desired in the castings.

The old forms of double chaplet (Figs. 6 and 7) still predominate in the majority of moulding shops, and are specially used for strengthening cores that are subjected to heavy pressure. For lateral strengthening they are less suitable than the stamped form of chaplets shown in Fig. 8, which also unites better with the molten metal, so that the cleaned casting reveals no trace of the chaplets.

Where an extremely heavy core has to rest completely on double chaplets in the mould, the tinned wrought-iron ones may be advantageously replaced by heavy ones of cast iron (Fig. 9), which are cleaned up quite bright so that they will unite better with the molten iron. Both plates of this type of support are grooved round the edges in order to give them a secure hold in the casting. These cast-iron supports are much cheaper than wrought iron, only a relatively small number being required in each case.

The tinned spike (Fig. 10), which is chiefly used for fixing cores for thin castings, especially pipes of small diameter, has had to face the competition of the doubled spike (Fig. 11) for 'green' moulds. This latter, however, is unsatisfactory, the limbs tending to separate when pushed into the mould, whilst a springy support is given, owing to which the sand is loosened and the castings are often defective, if not spoiled altogether.

Scrapping of Patterns.

By W. Peters.

One of the troubles of the foreman pattern-maker's life is the difficulty of knowing when and why to scrap patterns; it is easy to say "Oh! scrap it," but it is not easy to give a reason, or perhaps it would be more correct to say, make the principal see the reason, for scrapping it, if it has been done without his special instructions (and sometimes even with them), when the pattern that has just been scrapped is the very thing that is wanted, which frequently happens.

There is an old saying, "Keep a thing for seven years, and you may find some use for it." This may be true in many cases, but is a little incorrect when referring to patterns. Patterns that have not been used for that length of time may safely be put down as not being required. Engineering requirements are moving so quickly that in many instances what was new seven years ago is now practically obsolete, or, if not actually obsolete, is so far out of date as to make it not worth while renewing. One often wonders how many machines have been doctored-up which would otherwise have been, with advantage, thrown on the scrap heap, simply because there has been a pattern handy from which a renewal casting could be made cheaply.

The storing of patterns is alright when they are of standard designs and sizes, or are likely to be in constant demand; but if they are only for odd or unusual articles, it is a question as to whether it pays to store them. There is no doubt that it did pay to do so a number of years ago, when it used to be stated that patterns cost a guinea an ounce; but since then pattern-making has progressed, and a different complexion has been put upon the subject. At that time it was counted as a sacrilege to produce a pattern without bestowing upon it all the care (and sandpaper) that was possible, even though only one casting was required, or simply a makeshift pattern wanted. But machinery and competition have changed all that, and pattern-making is not now looked upon as being so much a necessary evil, but rather as an adjunct to the general progress of engineering. Consequently, owing partly to the improvement in machinery, but more so to the way in which patterns are now made, there is not the same hesitancy in trying or adopting new designs of machinery which require the making of new patterns. It is now common practice to make experimental or single casting patterns as cheaply as possible, both in labour and material, and it is surprising how comparatively cheaply these can be made when the foreman pattern-maker, in conjunction with the moulder, sets his wits to work, and at the same time gives the men to understand that the pattern is likely to be scrapped in place of being stored after using.

Large sums of money have been, and are still being spent on elaborate storerooms, which only invite the reception of patterns that are really not worth keeping. The interest alone on the capital thus expended would pay for the renewing of the few odd patterns which it might be found would again be required; in these cases, the only advantage likely to be gained by storing would be the time saved through having the pattern in hand. Against this there is the probability that the pattern, if stored, will not be required for some considerable time, if at all, and when it comes to be used there is the possibility of it having become so warped or altered in size, through the timber not being thoroughly seasoned, or through the pattern having been exposed in alternate damp and dry atmospheres or subjected to change of temperatures, etc., that it is not fit to use until there has been nearly as much time and money spent on it as would have been the case for a new one.

In this question of the reduction of cost for pattern-making the draftsman can be of material assistance by keeping out of his designs those elaborate and intricate details which are often only put in for the sake of appearance, and do not add one iota to the utility of the machine, although considerably increasing the cost of manufacture. He should remember that there is also beauty in simplicity of design, and quite as much money to be made out of it.

There are, also, other expenses which would be saved by scrapping these patterns, such as the cost of keeping a record, or the time which is usually spent in looking for them, insurance, etc.; but perhaps enough has been said to show that to scrap a pattern is not always the worst evil that could befall it.

Furnaces for Heat-Treatment Processes.

It is well known that profound changes may be introduced into the internal structure of metals and alloys by simply causing them to pass through certain ranges of temperature at varying rates of change, without subjecting them to any form of mechanical force applied by machine or by hand. Alterations thus brought about by the effects of heating and cooling are termed the results of heat-treatment. During recent years the heat-treatment of metals and alloys has received a considerable amount of attention from metallurgists. With regard to steel and other ferrous metals and alloys, the experiments of Brinell and others have conclusively proved that by simply raising the temperature of the material slowly (the rate of heating and cooling depending upon the hardening constituents present, and the mass of metal treated), and then quenching it in a liquid, solid or gas, followed by a reheating and by still another quenching, remarkable effects are produced in the mechanical properties of the heat-treated material. In the case of brasses, bronzes and sundry other non-ferrous metals and alloys, the published investigations of Thurston, Charpey, Shephard and others have demonstrated that great improvement in the quality of these metals can be brought about by heat-treatment only. It is scarcely necessary to emphasise the important part that this treatment plays in modern engineering practice. Many large firms treat all steel before machining, and by so doing obtain an increased output and reduce breakage of tools to a minimum.

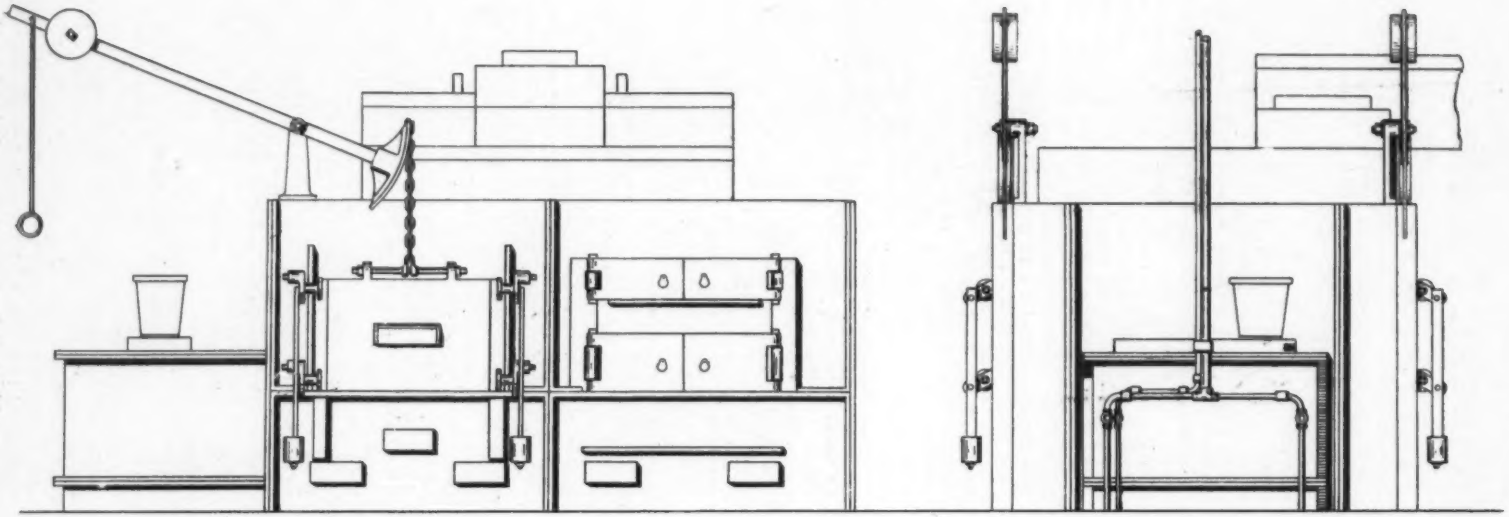
Obviously the practical advantages of heat-treatment are rendered abortive if means are not employed for conducting the operation in such a manner as to prevent deformation or alteration in dimensions of the finished article after subjection to the process. To overcome this, recourse has been had to enclosing the finished article in a closed vessel, heated and filled with powdered charcoal, flue dust and even with gases, or by filling up vacant spaces as much as possible with waste articles of the same material as those under treatment. The end in view was to displace the air as far as possible and then rely upon the further displacement of the residual by the evolution of occluded gases in the material, or released surface films of gaseous and organic matter in the closed receptacles, and that whilst the contents were being heated in the furnace. It is obvious that only in exceptional cases would the above procedure lend itself to rapid output, while when dealing with large turnovers in costly metals and alloys, the interest on capital outlay during the conduct of operations would be an item for consideration, so that any improvement or device which obviates the necessity of packing the finished articles in boxes is an important step in the direction of economy.

To meet such a demand Mr. T. Vaughan Hughes, of Messrs. Vaughan Hughes & Baty, consulting engineers, of 130, Edmund Street, Birmingham, invented a process in 1899 and patented it in 1902. In his specification he described sundry methods of applying it to heat-treating operations so that they might be conducted continuously or intermittently as circumstances rendered expedient. During Mr. Vaughan Hughes' researches some ten years ago, he ascertained that in contradistinction to all existing methods, it is necessary, in order to obtain the best consistent results, that the articles to be heat-treated should be surrounded by gases, inert in respect to the metal or alloy dealt with at the temperature attained and, what is essential, kept in movement, so as to sweep out occluded gases and surface films evolved during the raising of the temperature in the heat-treating process. Further, the reaction of the stream of inert gases, when properly composed, the inventor claims, removes some of the injurious constituents of the metals under treatment. Thus in steels the sulphur, phosphorus and nitrogen are removed in quantity dependent upon the time involved in the heat-treatment. Naturally the carbon content can, if necessary, be altered—all these without oxidising or scaling the finished article.

It is claimed that similar results accrue in non-ferrous metals and alloys by applying the Vaughan-Hughes process, but of special interest is the removal of films of lubricant and vaporisable organic substances, which in all closed methods of heat-treatment result in stains upon the finished article. At first sight there would appear to be many methods of overcoming these difficulties. Thus, why not water-seal the entrance of the furnace and pass the articles to be treated through the water into the hot space and out through another water seal into the air? In the first place the heat-treatment of ferrous metals and alloys cannot be conducted in any furnaces having a water seal exposed to the hot atmosphere of the heat-treatment space or muffle. In the second place water seals are only permissible with a few non-ferrous metals and alloys, such as copper, pure and standard silver, nine-carat and low alloys of gold, when applied to certain purposes. Brass of the better qualities is deteriorated by quenching, irrespective of other defects; it will therefore be understood that liquid seals are precluded from use in the heat-treatment of most metals and alloys.

The means adopted by Mr. Vaughan Hughes for overcoming the difficulties described above and achieving the desired results are not without interest. The method of heating the treatment space is immaterial. Mr. Vaughan Hughes in his first patent (1902) described both gas-firing and electric heating—a bath of fused salts heated by the passage of a current between electrodes or externally by any other source of heat. However, as the result of years of experience, he has now fallen back upon gas-firing mainly. He found the fused salts only suitable for small work in steel. Large pieces of finished work, being heated too rapidly, were liable to incipient cracks, and sometimes to complete fracture, whilst fused salts in a workshop constitute a serious nuisance. When heat-treatment and subsequent tempering at lower temperatures is desired the inventor recommends lead baths, and has designed such a bath for a manufacturing firm in the Midlands, which is in regular work, holding seven tons of molten lead.

The very essential sweeping out process is obviously unattainable in a molten liquid; thus, all the Vaughan-Hughes furnaces for the preparatory heat-treatment of steels have the treatment spaces filled with moving hot gases. These in most of the furnaces dealing with finished work of large size are combustible, and after passing through the treatment space are burnt to supply the necessary heat. A heat-treatment should, of course, be independent of all other furnaces, and to this end the inventor decided to attach a gas producer to each furnace or block of furnaces—the division of the units being determined by the character and extent of the operations to be conducted in a block and the output and exigencies of the total furnace equipment. The gas producer has recently been re-designed to comply with the best practice and continuous working; it is grateless, and can be charged



FRONT ELEVATION. SIDE ELEVATION.

FIG. 1.—VAUGHAN-HUGHES FURNACE FOR CASE-HARDENING, NORMALISING, ANNEALING AND TEMPERING MOTOR-CAR PARTS, HIGH-SPEED TOOL STEELS, ETC.

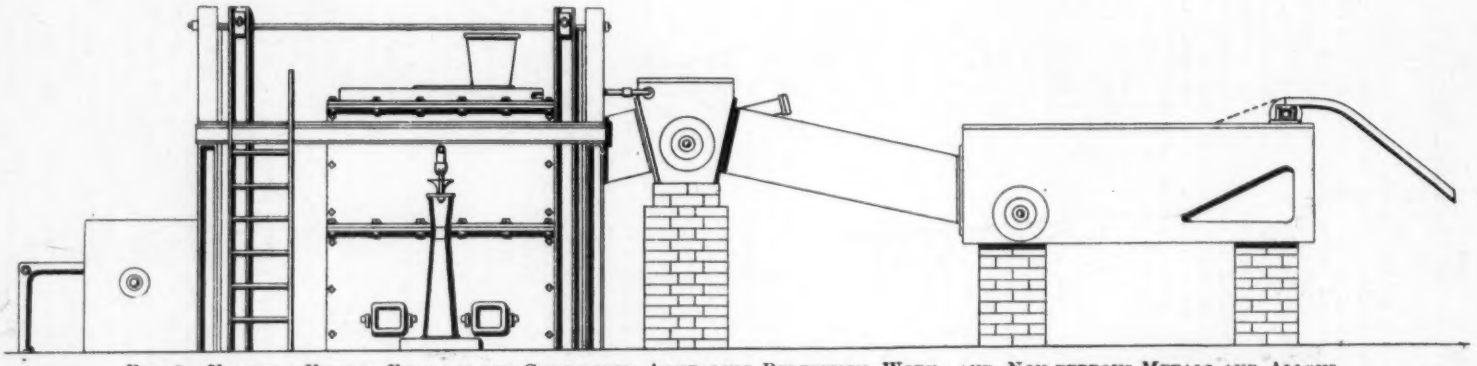


FIG. 2.—VAUGHAN-HUGHES FURNACE FOR CONTINUOUS ANNEALING REPETITION WORK, AND NON-FERROUS METALS AND ALLOYS.

without materially altering the quality of the gas.

It will be gathered from the foregoing that the heat-treatment spaces in these furnaces are separated from the combustion chambers—or heat-giving devices. In his gas-fired furnace the inventor utilises a "mixed" gas having little (if any) "crackable" hydro-carbons in its composition. He adopts well-known means for controlling the hydrogen contents, thus relying on the other "permanent" gas which has been proved to yield the highest furnace efficiency. Not only is a high temperature of the heat-treatment or laboratory space more quickly attained, but what is of the utmost importance, it can be regulated at will, both as to rapidity and evenness with precision and ease. This evenness of heating, in the absence of tar and crackable gaseous hydro-carbons, is made possible by the principle of reversed flue construction. The limits of temperature are controlled by the amount of recuperation to which the air admitted for combustion is subjected, both main gas and air supply being under separate control by very simple devices. The character of the non-oxidising gas in the laboratory space has already been alluded to.

Fig. 1 illustrates a furnace for case-hardening, normalising, annealing and tempering motor-car parts, etc., and similar work. This furnace has a clear heat-treatment space of 6 ft. long by 3 ft. 4 in. wide by 2 ft. 3 in. to the skewback of the muffle hearth.

Fig. 2 exhibits a furnace for continuous annealing repetition work, and certain non-ferrous metals and alloys, such as copper wire and stampings, cartridges, common brass stampings and pressings, standard silver and nine-carat gold.

The Institute of Metals.

In our last issue we published abstracts of some of the papers read at the autumn meeting in Manchester, of the Institute of Metals, at the end of October last. We now present particulars of the discussion on the papers. The retiring President, Sir William White, was succeeded by Sir Gerard Muntz.

Aluminium-Copper-Tin Alloys.

The discussion on the paper by Mr. J. H. Andrew and Mr. C. A. Edwards on "The Constitution and Properties of the Ternary Alloys, Aluminium-Copper-Tin," was rather, as was inevitable from the nature of the Paper, on the scientific as distinguished from the practical side.

Dr. H. C. H. Carpenter said it was almost tragic that the commercial possibilities of these alloys were confined to so small a number, but at least the establishment of that fact was likely to prove very useful to the industry, as it would only be necessary, when experiments were carried out in works on a larger scale, to concentrate attention on those alloys which this research had marked out as being capable of industrial application. A fact of great interest which had been brought out was the insolubility of tin in very many alloys. This was a somewhat remarkable feature, and it appeared to him to have a very important commercial bearing. The work indicated the possibility that aluminium at its present price might be used to extract tin from tin residues, which were not at present worth working, to an extent which would make the operation commercial. That was a point which could not be taken up in the laboratory, but it was a logical conclusion of what had been done.

Mr. A. Sinclair gave the meeting some details of an investigation he had made with aluminium alloys. In many cases he found that after prolonged experiments in sea-water the alloys were very little less in weight than before. When treated as a galvanic couple an astonishing result in this direction was achieved with an alloy consisting of 10 per cent. of aluminium and 90 per cent. of copper.

Mr. J. Brentnall said that in making manganese bronze castings one great difficulty was to prevent them leaking under pressure, but at the last meeting of the Institute a member had said that an alloy of aluminium and tin had very remarkable properties in regard to corrosive action. He had carried out some work on those alloys, beginning with 50 per cent. tin, and 50 per cent. aluminium, and found out that when copper was added the corrosive action was diminished until with about 10 per cent. of copper it was hardly noticeable. With a greater percentage of copper the action was not so much checked. On the other hand, the addition of zinc to an alloy of tin and aluminium increased the corrosive action enormously, and with 95 per cent. zinc and 5 per cent. tin and aluminium the action was so great that it was possible to collect gas at the rate of 250 cubic metres in half an hour. The matter ought not to be allowed to rest there, and he thought if the subject were carefully investigated on scientific lines it might lead to interesting results.

Mr. O. H. Hudson said that the appearance of the gamma-phase destroyed the use of the alloys. The authors of the Paper had done excellent service to the industry, as it was of the utmost importance to determine at what point the brittle condition appeared.

Sir William White said that a research was in progress by Dr. Rosenhain, who had followed Dr. Carpenter in that work, for the Alloys Research Committee of the Institution of Mechanical Engineers. He was the Chairman of that Committee, and was familiar with the results which had been reached in connection with ternary alloys. Those results would very shortly be brought before the Institution of Mechanical Engineers, and they would be found of extreme interest if read in connection with the work of the authors of the Paper. The fixing of the limit of alloys of practical value had, as previous speakers had intimated, involved an immense amount of work, and had opened up to the practical man an opportunity of making tests on those alloys which might prove useful in commercial work.

Copper-Zinc Alloys.

The Paper by Professor Thos. Turner and Mr. M. T. Murray, on "The Copper-zinc Alloys: a Study of Volume Changes During Solidification," attracted very favourable comment, Mr. Vaughan Hughes characterising it as one of the best Papers of the kind presented to any technical society for some years past.

Mr. Bengough found the Paper of great practical as well as scientific, interest. From the practical point of view the curve of total shrinkage should prove of considerable importance, as it varied very greatly in the different alloys and with different sizes of castings. Perhaps if the results had been presented in tabular form they would have been more readily available for practical purposes. Much interest attached to the agreement between the Brinell and the scleroscope tests, but it should have been noted that these only held for cast alloys, and were

not applicable to rolled, forged, or worked material. With rolled material the hardness, as shown by the scleroscope, increased more rapidly than with the Brinell hardness number. He would draw attention to the resemblance between the Brinell test and the tensile results given in the Fourth Report of the Alloy Research Committee.

Dr. Desch said he failed to find any proof in the Paper that a true expansion of volume occurred on the passage of these alloys from the liquid to the solid state, and, indeed, there were not wanting evidences that contraction took place. The apparent expansion was, he suggested, due to the thrust exercised during the growth of crystals. The point was one of scientific interest, but, of course, it did not matter from the practical brassfounder's point of view, whether it was a true expansion or a mechanical action. The expansion of bismuth on solidification had been firmly established.

Mr. Rhead thought that microscopical examination might throw some light on the suggested thrust due to expansion.

Sir William White said a point of the highest importance was that there should be multiplication of observations at the points where the conditions were discontinuous. He understood that this had been done. Whatever the explanations which might be given to the facts recorded, the Paper was one of the most notable which had yet been put forward on the subject.

Dr. Walter Rosenhain (Teddington) wrote that he felt some little difficulty in accepting the indications of Professor Turner's "extensometer" without reservation where volume changes during solidification were concerned. There was no need, however, to elaborate them beyond pointing out that while data of observed expansions appeared to rest on a satisfactory foundation, the negative results contained in the Paper—as regards the non-expansion of certain metals and the non-contraction of others appear to require confirmation by other methods. It was fortunate, however, that perhaps the most interesting portion of the Paper dealt with actual observed expansions, so that the correlation of the expansion with the equilibrium curves of the brasses remains as a most valuable forward step in our knowledge of alloys. Although he was unable to accept the data as final he felt that metallurgists were under a very considerable obligation to Professor Turner for thus breaking new ground.

Elastic Breakdown of Non-Ferrous Metals.

The next Paper presented was that by Professor C. A. M. Smith, of the East London College, on "The Elastic Breakdown of Non-ferrous Metals."

Sir Gerard Muntz said that the author made reference to the difficulty of obtaining non-ferrous metals suitable for experimenting. His complaint was the want of uniformity in the specimens. That was one of the great troubles in the non-ferrous metal trades, and it was one of the difficulties which the Institute was formed to overcome. He had frequently had experience of varying results, arising from what was apparently the same process. Manufacturers had to meet the requirements of engineers in regard to tensile strength, elongation, and elastic limit, and it was often a great trouble to comply with the stipulated conditions and get the material accepted. All sorts of problems arose; problems connected with the heat treatment; and how often and how long material had been in the furnace during the various processes of manufacture. These things greatly affected the ultimate result obtained. Beyond that was the question of the mechanical treatment, as one piece of copper might have had more work put upon it than another. It was necessary to accumulate scientific data as to the effect of varying mechanical treatment. In his own works these things were constantly being investigated, and he had been supplying specimens for scientific research for a long time past. It was hoped to find out more about the effect of various processes upon copper.

Mr. Boeddicker also referred to the difficulty of obtaining uniform material. There were several compounds, however, which should answer Professor Smith's requirements.

Mr. Edwards also drew attention to a material having excellent qualities—the alloy of 90 per cent. aluminium and 10 per cent. copper.

Mr. Parker criticised the Paper and general methods of testing material in a long speech. He agreed with other speakers that the Paper was of extraordinary importance to engineers, owing to the fact that it threw light on the different results obtained due to the difference in methods of testing. He was a great advocate of more scientific methods of testing, and he was bound to say that much of the testing done in this country was carried out in a very slovenly manner. The difference in the methods employed made it very hard for manufacturers to get the material accepted. He did not consider the sphingometer, used by Professor Smith, suitable for commercial work, preferring the Unwin instrument as the only commercial apparatus on the market. The Unwin extensometer was rapid, accurate, and not easily damaged, and would measure to the 20,000th of an inch. Wedge grips for holding round and square specimens should be discarded, and screw nuts and screw grips with spherical seats should be made compulsory for testing round specimens. He would point out that the phenomena of overstrain had an important effect upon the modulus of elasticity, and for the correct determination of the elastic modulus, it was essential that the specimen should not be stressed in any way prior to the actual test. It was confusing to say that overstrain made metals more elastic; what it did was to increase the range of stress over which they were elastic. A grave omission in the Paper was the absence of permanent set curves, and, in his opinion, both stress-set and stress-strain curves should be given with research reports. Stress-set curves were highly important to designers of petrol motors, high-speed turbo-generators, and other modern high-speed machinery. A definition of elastic limit was badly needed, and he hoped the authorities interested would take steps to obtain it. For engineering work the best definition would be the stress per square inch, which produced a permanent set of exactly 0.001 in. on a gauge length of 2 in.

Sir William White, in closing the discussion, appealed to manufacturers to supply the East London College with specimens, in order that the work might be continued, with the view to arriving at a greater knowledge of the properties of the non-ferrous metals.

Professor Smith, in replying on the discussion, questioned whether any treatment of copper would give it the desired uniformity. He was glad to hear from some of the speakers that uniform materials could be obtained, and he was most anxious to obtain specimens of those referred to. On the subject of the criticism passed by Mr. Parker on the employment of the sphingometer, trouble might arise in a shop from vibration, and for perfectly correct measurements there must be no vibration, but the whole point of the instrument was that it was easy to test and correct from interference in the shape of vibration.

The Bristol Recording Pyrometer.

By Percy Longmuir and Thomas Swinden.*

In a paper read before the American Society of Mechanical Engineers in 1906, Professor Bristol described a low-resistance thermo-electric pyrometer designed to meet the severe conditions of ordinary shop use. The pyrometer, as described, could fairly be called a "shop tool," and, as such, entered largely into American works practice. So far as the authors know, these pyrometers are new to this country, hence the following experience with an installation of the latest design will be of value to those interested in temperature measurement.

At the outset the authors' cordial thanks are tendered to Mr. H. Pilkington, of the Sheepbridge Coal and Iron Company, Limited, for the practical facilities afforded in the form of a continuous works test. The object of the test was to ascertain the behaviour of the pyrometer under normal works conditions, as for example in continuously recording hot-blast temperatures.

The accuracy and utility of the thermo-electric

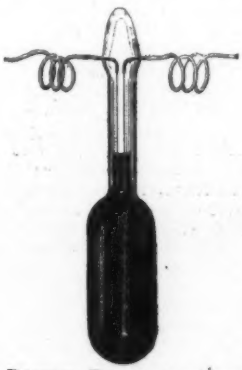


FIG. 1.—BRISTOL RECORDING PYROMETER.

pyrometer, as introduced by Le Chatelier, are now beyond question. From the purely works point of view, two difficulties lie in the delicacy of the galvanometers and in the decay of the platinum and platinum-alloy thermo-elements. An example of the latter is found in the effect of reducing atmospheres, and platinum thermo-couples have a comparatively short life when used in flues, gas mains, or similar situations. Even in oxidising atmospheres, such as annealing furnaces for the production of malleable cast iron, the cost of the platinum thermo-couples, when continuously used, is an appreciable factor per ton of castings annealed.

One distinguishing feature of the Bristol pyrometer is the use of an inexpensive thermo-element. The durability and accuracy of the element selected will be referred to later. The electro-motive force of these thermo-couples is much greater than that developed by platinum alloys; hence, a Weston millivoltmeter replaces the delicate high-resistance instrument essential to platinum couples.

The thermo-couple wires are insulated by asbestos cord, and then coated with carborundum paint, further protection being afforded by means of a metallic tube. The couple wires are comparatively thick (about No. 5 gauge), hence the difficulty arising from variations in the resistance of the thermo-element with varying temperature is almost eliminated.

The electro-motive force developed by the thermo-couple may be read directly in degrees C. or degrees Fahr. on a portable milli-voltmeter. The authors are informed that a portable instrument of this type is in use on an English locomotive. The installation tested was of a stationary type, consisting of indicator, recorder, and switch-box. The various connecting cables are fitted with terminals of special design, by means of which it is almost impossible to connect up incorrectly. One couple actuates both indicator and recorder, hence the former is placed near the furnace, and the latter in any position accessible to the management. The switch-box included in the system contains compensating resistances, so that switching out either indicator or re-

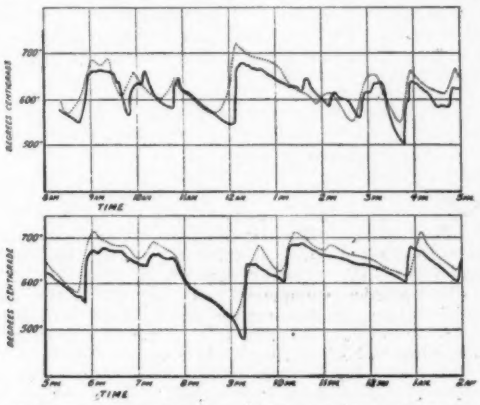


FIG. 2.—COMPARISON OF ROBERTS-AUSTEN AND BRISTOL RECORDS.

Dotted Line = Roberts-Austen Curve.
Black Line = Bristol Curve.

corder does not affect the reading of the one remaining in the circuit.

The recorder presents many interesting features. The records are made on a smoked chart, graduated in time and degrees C. or degrees Fahr. The chart, set to correspond to the time of the day, is revolved by clockwork, and, at short intervals, is brought in contact with the pointer of a milli-voltmeter actuated by the thermo-electric current. This vibration eliminates friction between the pointer and chart, but the intervals are so short that a continuous line results. The chart gives a 24 hours' record, and is entirely visible, so that at any time temperatures may be read directly from the recorder. The charts are subsequently fixed by soaking for a few seconds in a fixative, and, after drying almost spontaneously, are quite hardened, and may be filed for reference. Changing records and fixing occupies only a few minutes per 24 hours; this, and winding up the clock, represent all the attention required.

An important feature, and one which is not always allowed for, is the temperature of the cold junction. The net electro-motive force produced in any thermo-electric circuit is dependent on the difference in temperature of the hot and cold junctions. Many

* Proceedings of the Iron and Steel Institute.

instruments are calibrated and supplied to read correctly with a cold-junction temperature of from 15 degrees to 20 degrees C. Others neglect the cold junction entirely. Bristol has designed a unique "compensator," which will automatically correct for variations in temperature of the cold junction. This has previously been described by one of the present authors,* and is illustrated in Fig. 1. It consists of a glass bulb with a short stem, into which two platinum wires are fused. These are in turn connected within the bore of the stem by a loop of fine platinum wire. The compensator is placed in the circuit at the cold junction, and it will be seen that, if the temperature rises, the mercury in the bulb will rise up the stem, thus cutting out a certain portion of the platinum wire, and therefore reducing the resistance of the circuit. The compensator is so calibrated that for a given circuit the reduction in resistance just counterbalances the diminution in electro-motive force due to the rise in temperature of the cold junction.

A complete installation suitable for use in blast-furnace practice, either for hot-blast or top-gas temperatures, has been thoroughly tested on a modern blast-furnace in the following manner.

The apparatus was set up to record hot-blast temperatures of the No. 5 furnace belonging to the Sheepbridge Coal and Iron Company, Limited, Chesterfield. A platinum thermo-couple leading to a Roberts-Austen pyrometer is permanently installed in the same blast main, but the two couples were some distance apart. In connection with setting up, it should be noted that Bristol instruments are of low resistance, hence it is necessary to know beforehand the length of leads required, in order that the instruments may be adjusted to the length actually used. In the case of platinum couples and high-resistance galvanometers, where the total resistance of the whole circuit runs between 200 and 500 ohms, a few hundred feet of leads has but small influence on the resulting current.

The recorder commenced on May 26, 1908, and shortly after commencing the temperature read from the recorder was 610 degrees C., against 615 degrees C. by the Roberts-Austen instrument.

The real point to decide was whether the accuracy would be maintained over a prolonged period. The recorder worked well, and charts are to hand giving a continuous record of the blast temperature up to the end of July. During August the furnace was damped down owing to a strike. When restarting on September 1, 1908, it was noted that for several hours the record showed a uniform temperature of 100 degrees C. instead of a gradual rise. It then rose quickly to 300 degrees C., and subsequently showed no further vagaries of this kind. This was the only trouble encountered during the whole of the run. The reason is hard to give, but it is most probably due to some slight retardation in the movement of the pointer as a result of its standing inactive for several weeks. The indicator showed no such retardation.

Comparison made during the test run showed good agreement in readings obtained. As an example, a Bristol curve and a Roberts-Austen photographic curve have been replotted to the same scale, and are reproduced in Fig. 2. The two couples were in the same blast main, at some distance from each other. Noting this, and also the fact that the cold-junction temperatures would differ, the agreement in results is perfect. The instrument used by the authors was calibrated for a normal cold-junction temperature of 25 degrees C., and had no compensator in the circuit.

* T. Swinden, "Some Methods of Measuring High Temperatures." "Proceedings of the British Foundrymen's Association, 1906."

Fig. 2 represents one of the early records, but the accuracy shown was maintained throughout the test run.

The complete installation was removed to the authors' laboratory on September 23, 1908, in order to restandardise, and thereby ascertain the effect of continuous exposure in a temperature range of 600 degrees to 700 degrees C. Visual examination of the thermo-couple and protecting tube showed no change in condition. Comparison with a previously standardised platinum-iridium thermo-couple in a temperature range up to 900 degrees C. gave remarkably concordant results.

The bulkiness of the Bristol thermo-element junction renders standardisation by the usual methods—boiling and solidification points—somewhat difficult as regards manipulation. Hence the method adopted of comparison at various temperatures with a previously standardised platinum couple.

In works practice the best plan would be to keep a stock of couples, reserving one as a standard for periodically checking the constancy of the couple in regular use. The construction of the terminals is such that a couple could be changed within a minute. The low cost of the couples makes this method cheaper than the usual calibration.

Exact information as to the normal working life of the couple was desired, and this has not been obtained. The results show that under the conditions described the thermo-electric properties of the couple have not been materially affected. In other words, accuracy has been maintained, and the indications are that the couples will give extremely good life. The mechanism of the recorder is admirably suited to works conditions. Strong magnetic fields may possibly affect the readings, but this difficulty is not often encountered. The real trouble in the case of most recorders, that of vibration and shock, is practically overcome. For example, the recorder used in this test was screwed on to the wall of a small house, built over a gas-flue, and within a short distance of the blowing-engines.

In reference to the foregoing note on calibration and the life of the couple, the following instance is of interest. With platinum couples frequent calibration is indispensable, and a point worthy of consideration may be mentioned here. The general curve for electro-motive force of a couple against temperature, for temperatures between boiling sulphur (446 degrees C.) and solidifying silver (962 degrees C.) is practically a straight line. With slight deterioration of couple the curve still retains this form, but a marked deterioration results in an irregular curve. Errors may also arise from variation in galvanometer constants, as, for example, in the suspension wire or permanent magnet, and in cases of this kind the net error is of a complicated nature.

THE FRENCH TARIFF BILL.—It was stated in the course of a discussion on metals in the French Tariff Revision Bill, that iron at Middlesbrough with freight and railway carriage would cost, in the east of France, 83 fcs. 50 c. per ton, including trade profit; Belgian, 76 fcs.; German, 73 fcs. 50 c.; while it could be sold in France with a profit at 58 fcs. 50 c. Competition with Belgians was not to be apprehended, as, though they have coal, they are tributary to France for ore. It is only in the regions bordering on the western seaports that English iron could be sold with profit. It was proposed to reduce the duty on pig-iron to 5 fcs., but, after a long discussion, the amendment was rejected, and the duty of 15 fcs. was voted.

A Stourbridge Foundry.

Visit by Birmingham Foundrymen.

The members of the Birmingham Branch of the British Foundrymen's Association were informed at their meeting on October 23, that if they wished to see an up-to-date foundry they should take part in the visit which had been arranged for October 25, to that of Messrs. Jones & Attwood, of the Amblecote Engineering Works, Stourbridge. More than thirty members accepted the invitation, and the visitors were received by the proprietor, Mr. Jones, and the foundry manager, Mr. Wright, with other members of the staff.

The foundry forms one of the principal departments of a large engineering works, the erection of which was commenced by the firm in 1894 for the purpose of carrying on under better conditions an old-established business started in another part of the town. The works cover about two acres, and include a foundry of seven bays, averaging 120 ft. by 30 ft., a fitting shop, 100 ft. by 30 ft., a warehouse, containing six bays with a total floor space of 20,000 square feet, a large shop devoted to the manufacture of sewage distributing plant, a covered yard 140 ft. by 40 ft., and a fine suite of offices. About 280 hands are employed. The works are very near the canal and the Great Western Railway goods station.

The situation of the foundry is almost ideal. It was laid down in 1894 on a site excavated out of a bed of fine loam casting sand. Each extension, which has since become necessary, has yielded an additional stock of this sand, which forms the principal material used for moulding in the works, and as the bed yet extends some little distance beyond the boundary of the shops, and has a depth of about 200 ft., the supply is practically inexhaustible.

The first thing the visitors were taken to see was the working of the core-making machines, patented by the firm. One of these machines will make a 4-in. pipe core complete at one operation in one minute, or a 15-in. core with three successive coatings of sand in ten minutes; the same machine has a range from 1 in. to 20 in. diameter. Green sand without clay or loam is used, and is put on in three successive coats of decreasing thickness. The depth of each layer is regulated by a gauge key machined accurately to the given size and governing the movements of the reciprocating bar which distributes the sand. Cores can be made in this way not only for plain pipes, but also for socketed and double-socketed, even to five diameters, and the most delicate gauge requirements of Government work can be provided for. Taper cores can also be made on the machine. The moulding of cores for 15-in. sewage pipes was witnessed, and afterwards the casting of the pipes, and the extraction of the core barrel by raising the cooled casting almost upright by means of a crane. Other examples of casting were also witnessed, and the visitors were struck by the ingenious use of old bicycle chains as core irons in the loam cores used for such castings as kitchen boilers. The firm also make their own special moulding machines, and some of these were shown making moulds for a somewhat complex pattern of railway carriage ventilators. The foundry is served by a cupola melting 6 or 7 tons an hour. The regular output of the foundry is about 100 tons per week, melting twice a day, and the output includes pipes of all sizes, boilers for hot-water apparatus, and general casting work. The cranes and travelling gear are hand worked, but their arrangement is exceedingly handy and effective.

Passing through the yard the visitors noticed an example of the many little ingenuities by which time and labour are saved, in the shape of a small three-wheeled truck, on which one man can easily pull a ton of pig-iron, while with the handle of the truck a simple and effective brake is combined.

In the distributor shop, the visitors saw in the course of construction several sewage distributors, for which Mr. Jones holds six separate patents. These are made with rotating motion for circular beds, and also with automatic reciprocating motion for rectangular filter beds, for the bacterial method of sewage purification. The great desideratum in this method is the perfectly uniform distribution over the filter bed of the liquid which comes from the revolving or septic tank. The distributors made by this firm are actuated by the flow of the sewage itself. They consist of drums around which are mounted shallow galvanised troughs or buckets, after the manner of a water-wheel. Into these the sewage runs from little weir boxes, and the revolution of the drum causes the distributor to travel on rails resting on the walls of the bed. If the bed is rectangular, the distributor reverses automatically at each end. With a circular bed, the distributor is supported at one end by a central column, and at the other by a small wheel running on a circular rail, which is connected with the coping by means of adjustable chairs. There are other variations in the fixing of the apparatus, the distributor, for instance, in some cases being wholly supported from a pier in the centre of the filter. In the case of a circular distributor, the outlets of the weir boxes placed along the length of the drum are graduated according to the square of the radius, in order to secure equal distribution over all parts of the circular area. Two distributors were seen in motion, a rectangular one and a circular one, and illustrations were given showing how fully the motive power of the sewage flow is utilised. The distributor works automatically with a head of 15 in., and one of a size suitable for a small country house, will continue working, even with an added weight of half a ton. All the castings for this apparatus—the parts of which require to be made with minute accuracy—are made on the premises.

After a look at the fitting shop, which, like the foundry and other parts of the works, is clean, well-lighted, and equipped in the most modern fashion, the party was conducted to the offices. Before entering, a look was taken at the ventilating apparatus, which supplies the offices with washed air, cool in summer and warm in winter, and which is driven by an electric motor. Entering the drawing office the visitors were supplied with tea.

Mr. Cook proposed a very hearty vote of thanks to the firm on behalf of the visitors, and on behalf of the British Foundrymen's Association in general, and the Birmingham Branch in particular. It showed, said Mr. Cook, the progress they were making when a firm of that standing allowed them to go through the whole of their establishment during working hours, and exhibited such confidence in them, a confidence that he hoped would not be found to have been misplaced. They had never been on a visit where so much courtesy had been shown, and where those who received them had been so ready to explain everything as far as time permitted. They all knew of visits to works where they were simply handed over to boys who could not answer any questions, and were

just shown through and out again. Here, however, they had been told practically what a great many persons treated as trade secrets. They would all agree that such treatment deserved their very hearty thanks. (Applause.)

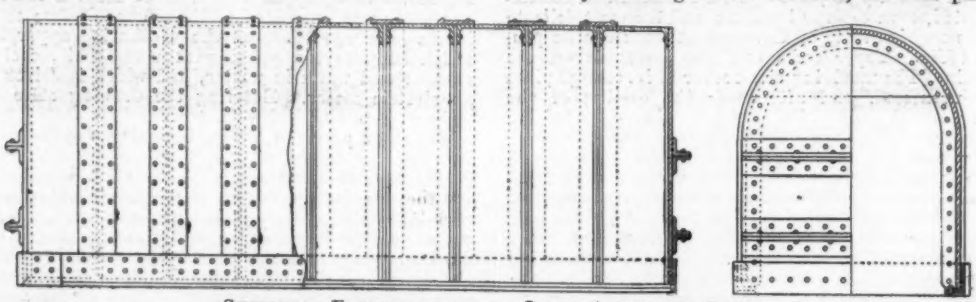
Mr. Buchanan, in seconding the motion, said that he had had the pleasure and honour of knowing Mr. Jones many years, and had always considered him to be one of the ablest men in the iron industry. Mr. Jones was not tied down by the traditions which so readily beset them all. No doubt it surprised many of them to find such a splendidly equipped little foundry at a place like Stourbridge. It was not difficult to see that that was a live works, and no doubt it would still progress, and go on making its mark. Although it was not exactly a foundry subject, he thought they must have been struck while going through the distributor section of the works, by the enterprise which the firm had displayed in taking up that important business, as well as by the ingenuity of the apparatus. He thought it was not difficult to prophesy that their enterprise would receive an adequate return. They were grateful to Mr. Jones and to Mr. Wright and the staff, for the exceptional opportunity that had been afforded. (Hear, hear.)

Mr. Jones, in reply, said that he was very pleased to see them there. Referring to the conditions of the present day, he said that he thought some of his visitors would have to look in the near future to see whether they were getting the due results of their labours. Huge trusts and syndicates were quietly squeezing the smaller firms out of existence in other trades, and no doubt that would come in the foundry trade by-and-bye, and they must prepare for a hard time. Gradually the ordinary working-class mechanical man was being squeezed out of existence. The men who were the backbone of the nation, men such as those before him, who were giving not only their brains and muscles, but everything else for the welfare of the community, were not getting for themselves anything like the results they ought to get. He would like some day to have the opportunity of talking these matters over with gentlemen such as those present, and seeing if it were possible to avert the evil of which he spoke. It seemed to him that they were giving too much for capital, as such, and too little for labour, as such. He was speaking about brain labour. Mr. Jones then proceeded to discuss the disproportionate amounts received by those who carried on industrial operations, and the landlords who drew huge sums as rents from industrial concerns. It was not right, he contended, that manufacturers, merchants and workers should be exploited to the extent they are at times. As an enterprising man, he tried to look ahead, and he saw in the future very serious trouble. They had had a good deal of unemployment during the last year or two, and it might be worse in the future, and he should like to see this problem discussed in a practical way irrespective of party politics. The competition of machinery, especially of automatic machinery, as they all knew, was gradually squeezing the workman out, and instead of finding the skilled workers they used to find thirty or forty years ago, they found most of the ordinary men in ironworks were mere machines, and, like machines, they were destined in a comparatively short time for the scrap heap. But they had got to provide these men with subsistence even when they were on the scrap heap. His opinion was that it was better to keep a man employed than to keep him on the scrap heap. (Applause.) In conclusion, Mr. Jones said that he was only too pleased to receive them at his works. If they had learned anything so much the better. When they had visitors, they endeavoured to learn something from them, and if they had picked up anything from the members of the Foundrymen's Association it would not be thrown away.

Mr. Buchanan gave Mr. Jones and Mr. Wright a cordial invitation to the meetings of the Birmingham Branch of the Association, and said that the aim of the Association was to make men not only better workmen, but also better citizens.

A New Annealing Box.

The annexed cut shows sectional elevations of the Leigh annealing box which has been designed specially to withstand repeated firing. It was the invention of employés of the Youngstown Sheet and Tube Company, U.S.A., and is used in their works with successful results. It is built of a series of channel bars bent in the form of the letter U with the flanges on the outside. These flanges, with a filler plate between them, are fastened together, the riveting all being inside the box, where it is protected from the fire. At distances of 15 in. along the length of the box, there are placed braces approximately 2½ in. thick by 4 in. wide, which are formed by the flange of the channels, the filler plates and the arch plates, and fan out into broad rafters in the crown of the box. The ends are made of ¾-in. plates, and have two pairs of heavy angles butted together and riveted. The boxes weigh from five to seven tons each, according to size.



SECTIONAL ELEVATIONS OF THE LEIGH ANNEALING BOX.

A 100-Ton Special Ladle Crane.

In the accompanying photograph is shown a special 100-ton ladle crane, installed at the open-hearth steel works of Messrs. Vickers, Sons & Maxim, Limited. The crane, constructed by Messrs. Applebys, Limited, of London, Glasgow, and Leicester, consists of a pair of parallel girders with a heavy crab running on the top flanges and a light crab running between the girders. The arrangement is such that in the case of the heavy crab the lifting ropes descend from a pair of barrels on both outer sides of the main girders, whilst in the case of the light crab the lifting ropes descend from a single barrel between the two girders; thus the one crab can pass the other crab in any position that either may occupy on the main girders, provided only that the lifting blocks of the heavy crab are sufficiently low, and that of the light crab sufficiently high. The crane, which lifts a working load of 100 tons on the heavy crab, and simultaneously, if desired, a working load of 25 tons on the light crab, runs on two pairs of rails distanced 46 ft. from the centre of one pair to the centre of the other pair.

100-Ton Special Ladle Crane at the Works of Messrs. Vickers, Sons & Maxim, Ltd.

The crane has five motions, each operated by a separate motor, either independently of one another or simultaneously if desired, namely:—Lifting and lowering heavy crab; traversing heavy crab; lifting and lowering light crab; traversing light crab, and travelling the complete crane. The motors are of the enclosed ventilated standard crane type, with the openings covered with wire mesh, and series-wound; the heavy crab lifting motor gives 100 b.h.p. running at about 600 r.p.m.; and the heavy crab traversing motor 25 b.h.p. running at about 420 r.p.m. The light crab lifting motor gives 50 b.h.p. running at about 500 r.p.m.; the light crab traversing motor 5 b.h.p. running at about 600 r.p.m. and the two travelling motors each give 25 b.h.p. running at about 420 r.p.m. The controllers are of the "Stellite" standard crane type, totally enclosed and fitted with magnetic blow-out coils; the resistances are of the "Stellite" standard crane type, consisting of cast grids insulated with mica in all cases, excepting that of the 5 b.h.p. motor, which is of the "Eureka" wire type wound on porcelain tubes, the resistances being so proportioned that they will withstand 75 per cent. of the normal current of the motors for five minutes without undue heating. The working speeds, which it is understood, are approximate to the extent of about 5 per cent. above or below the figures given, are:—

			Ft. per min
Lifting heavy crab,	full load	... ...	about 9
" " "	no "	... ...	" 22
" light "	full "	... ...	" 50
" " "	no "	... ...	" 50
Traversing heavy crab,	full "	... ...	" 75
" " "	no "	... ...	" 120
" light "	full "	... ...	" 75
" " "	no "	... ...	" 120
Travelling	full "	... ...	" 110
"	no "	... ...	" 160

The lifting gear consists of two cast-iron barrels, grooved right hand and left hand, and three reductions in duplicate of steel machine-cut spar gearing. An electro-magnetic brake is fitted to the first motion shaft, consisting of a cast-iron drum gripped by a leather-lined steel brake-band with weighted lever and operated automatically by a solenoid connected in series with the lifting motor. Automatic lowering devices are also provided consisting of screw threads cut in the second motion shafts and similar threads in phosphor bronze bushes contained in the spur wheels, together with steel ratchet wheels and pawls with suitable devices for rendering the latter noiseless when lifting and at once applying them when lifting ceases. A centrifugal governor is also provided on the first motion shafts, consisting of two steel shoes held in a cast-iron body keyed to the shaft and revolving with it, the shoes being held in place by steel bolts and powerful springs, and the whole enclosed in a cast-iron outer friction frame bolted to a cast-iron bracket fixed to the crab frame. The lifting gear consists of a cast-iron barrel grooved in the lathe right hand and left hand, and three reductions in duplicate of steel machine-cut spur gearing. An electro-magnetic brake and automatic lowering device is provided, being of the same description as for the heavy crab, which runs on eight traverse wheels, four geared and four ungeared, whilst the light crab operates on four traverse wheels, two geared and two ungeared. The travelling gear consists of eight pairs of double-flanged steel travelling wheels with machined treads, four pairs geared and four ungeared. The weight of the crane complete is about 100 tons.

The Grönwall Electric Steel Furnace.

The Grönwall electric furnace is of the arc type as opposed to the induction type, *i.e.*, the current is led into the furnace by carbon electrodes which strike and maintain arcs on the bath of molten metal or slag, but it marks a new departure in the arc type of furnace, inasmuch as two-phase current is employed, instead of the single-phase which

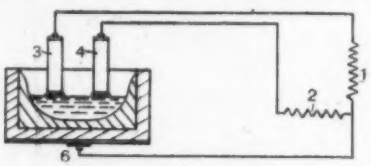


FIG. 1.—ELECTRICAL CONNECTIONS FOR TWO-PHASE CURRENT.

has been used hitherto in practically all furnaces that are working in actual practice. These latter may, again, be divided into two classes: (1) Furnaces with two adjustable electrodes and therefore two arcs in series, the current being led down one electrode to the bath and up the other electrode. (2) Furnaces with one adjustable electrode only, the current being led down this, through the bath, and out through the bottom of the furnace.

The Grönwall furnace is, in a sense, a combination of both types, but, as stated above, possesses the important feature that two-phase current is employed. The advantages of this over single-phase are as follows:—(1) The generating plant and transmission are much cheaper and more satisfactory in operation. Three-phase current can be generated and transmitted, and transformed into two-phase in the furnace room. In addition, these furnaces can be connected up to existing power mains, which is impossible with single-phase furnaces. (2) The peculiar effect of the two-phase current in the bath is to induce a vertical and horizontal movement of the charge, thus bringing every part of it into contact with the refining slag and securing an absolutely homogeneous product.

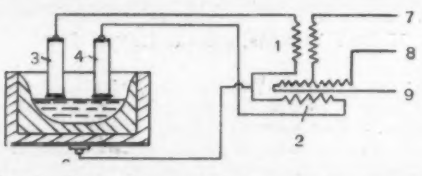


FIG. 2.—SCOTT CONNECTIONS FOR TRANSFORMING THREE-PHASE CURRENT INTO TWO-PHASE.

Figs. 1 to 5 show the arrangement diagrammatically, while Fig. 6 shows an actual furnace. Figs. 1 and 2 show the electrical connections, from which it will be seen that one phase is connected to each movable electrode, while the "neutral" point is connected to the bottom lining of the furnace;

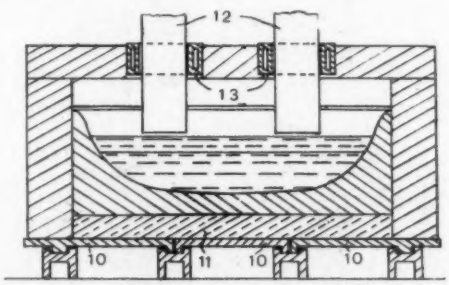


FIG. 3.—VERTICAL SECTION ON A.B. FIG. 4.

Fig. 1 shows the ordinary two-phase arrangement, while Fig. 2 shows the well-known Scott connections for transforming three-phase into two-phase current. The electrodes are separately adjustable, either automatically or by hand, and a perfect balance between the two phases can be maintained. Fig. 4 shows the furnace in plan, and Figs. 3 and 5 are vertical sections on the lines A B and C D respectively. The furnace is built up on the cast-iron plates, 10, which also act as conductors for the current; 11 is a layer of high conductivity graphite or carbon which serves the double purpose of a heat insulator, keeping the lining hot, and therefore a good conductor, and the plates, 10, cool;

and of a current conductor. The lining proper is similar to that of an ordinary open-hearth furnace, and consists in general of a rammed mixture of magnesite and tar. The electrodes project downwards through the vault, and are surrounded by

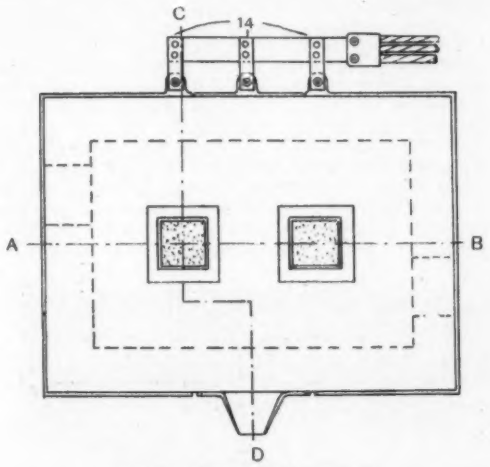


FIG. 4.—PLAN OF FURNACE.

the castings, 13, which in the larger sizes are water-cooled. Fig. 6 shows the tilting arrangements, the cranes for the carbons, charging doors, etc.

In this furnace it is claimed that all the operations of making every grade of steel, from the metal from the blast-furnace, mixer, converter, or open-hearth furnace.

The refining process, it is stated, can be carried further than is possible with any gas-fired furnace or electric induction furnace, and a more complete elimination of sulphur and phosphorus secured. This is due to the much higher temperature obtained, and to the fact that it is the slag which is raised to the highest temperature. The action goes on in a neutral atmosphere, there is no tendency to oxi-

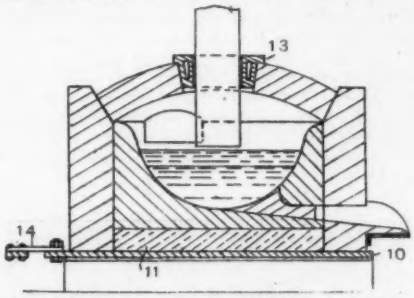


FIG. 5.—VERTICAL SECTION ON C.D. FIG. 4.

dise the metal, and no impurities are introduced by in-coming gases.

In all countries where coal is dear, the electric furnace can compete successfully for all grades of steel with the open-hearth furnace or Bessemer converter on cost of production alone. Where coal is cheap, the competition tends to be limited to the higher grades of steel, such as those produced by the crucible process.

Another application of the electric furnace of the greatest importance is for making steel castings.

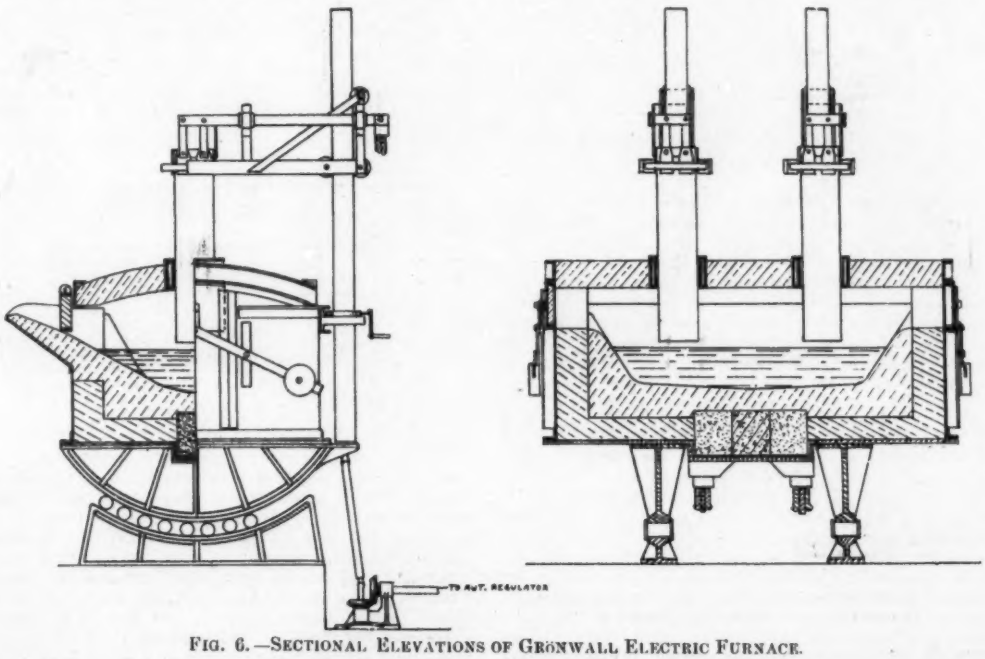


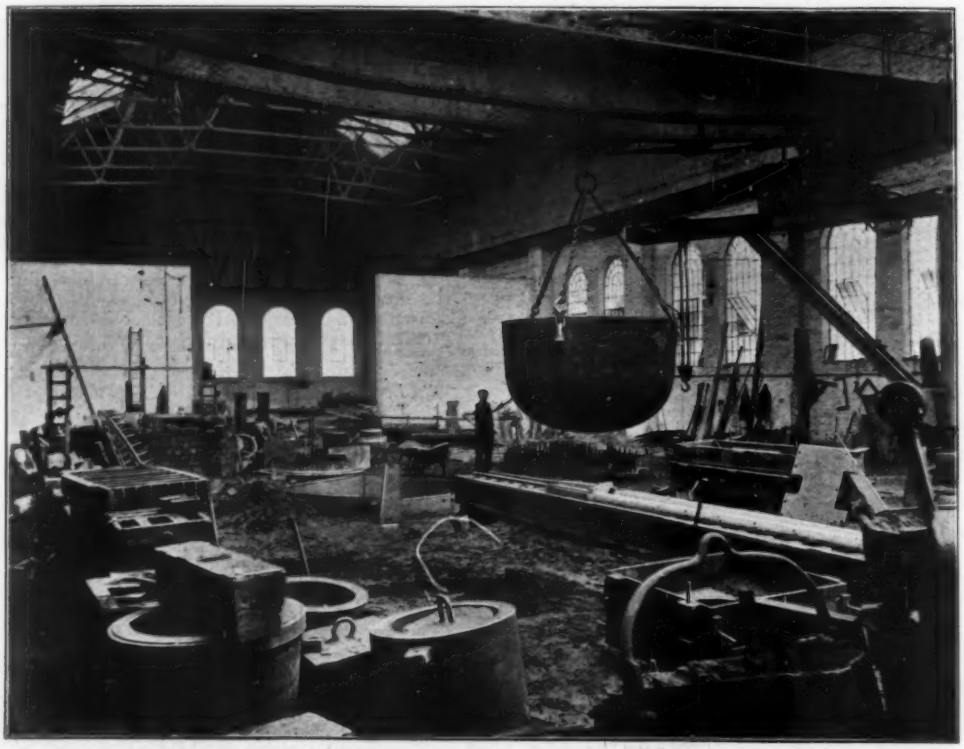
FIG. 6.—SECTIONAL ELEVATIONS OF GRÖNWALL ELECTRIC FURNACE.

highest class of high-speed tool-steel down to ordinary mild steel or pure iron, can be carried out, using as raw materials pig, scrap, etc., or molten

The castings produced by this process are unrivalled for quality, soundness, and freedom from blow-holes, and stand in a class by themselves.

Extensions to the Griffin Foundry, Oldbury.

Messrs. Hunt Bros. (Oldbury), Limited, have just completed somewhat extensive additions to the buildings and plant at their Griffin Foundry. For a considerable time the management have felt the need of more space, and although additions had from time to time been made to the existing plant, to enable the Company to cope with their increasing business, such additions, to a foundry built in the year 1839, did not lend themselves to the best economy of production. It was this consideration, and the growing demand the Company were experiencing for heavier castings, which led the management to decide upon the erection of an entirely new foundry and the necessary auxiliaries. They were able to purchase some six acres of land, adjoining the works, which amply provides for future contingencies. The old works consisted of two moulding shops, served by a cupola of a capacity of four tons per hour. The new foundry, which is 220 ft. by 62 ft. by 35 ft. high to the eaves, is built at the rear of one of the existing shops, the end adjoining which is of a temporary nature, the intention of the management being to continue the new foundry, in this direction, right up to the road, so as to have the foundry, fitting shop, and machine shop, together with the dressing shop, under one roof 450 ft. long by 62 ft. wide. There are four drying stoves each 20 ft. by 20 ft. by 10 ft. 6 in. high, the doors of which are raised by balance weights. A 20-ton electric overhead crane, by Messrs. Booth Bros., commands the floor, and two 5-ton jib cranes are also conveniently placed. Castings up to 40 tons can be made, and the total weekly output is about 150 tons. The Company make a speciality of square and round tanks, and one corner of the foundry is occupied by a machine for planing the edges of such tanks. Practically, this is a double-headed milling machine, with the table on the one side a fixture and on the other adjustable—in width, as also to any desired angle. Each of the heads is driven by a 6-h.p. motor. The tables are capable of taking work up to 12 ft. by 9 ft., planing both sides at one operation, either square or on the bevel, as the case may be.



THE NEW FOUNDRY OF MESSRS. HUNT BROS. (OLDBURY), LTD.

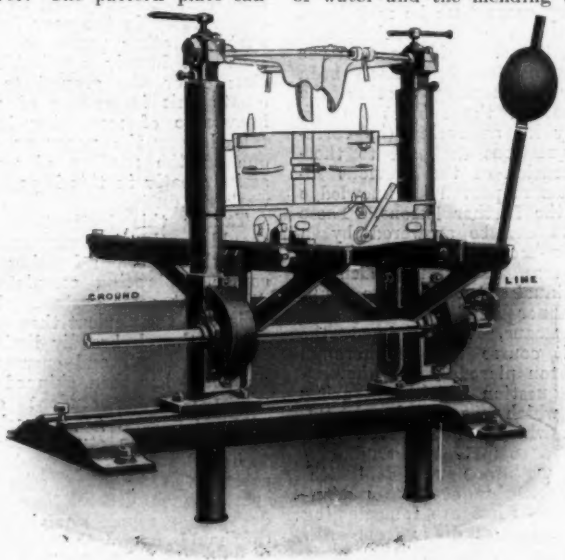
The new cupola has a melting capacity of 6 tons per hour; the loading platform is 30 ft. by 28 ft., and is built of steel girders supported upon columns. Material is conveyed from the ground level to the charging platform by an electric hoist (Booth Bros.), with a lifting capacity of one ton. Blast is supplied by a Roots blower, manufactured by Messrs. Samuelson & Company, Limited, Banbury, and driven direct from a 45-h.p. motor. The blower is equal to supplying the blast for both cupolas simultaneously, this being provided for in case of a breakdown of the older plant, while if necessary the old plant can be called upon to blow the new cupola. Adjacent to the cupola is a 15-ton air furnace, for melting special irons such as would be used for machine and other

special quality castings. Natural draft is obtained through a steel stack 90 ft. high by 6 ft. 6 in. in diameter. There are the usual foundry auxiliaries, including two rotary sand mixers.

The new pattern shop is 100 ft. by 60 ft., provision being made for extension at one end. This shop is particularly well lighted, and the floor is of wood blocks on concrete, which not only adds to the comfort of the men employed, but is also admirably adapted for setting out work. The shop is equipped with the best types of modern wood-working machines. Amongst others we noted two wood trimmers of the largest size, circular and band saws, and a combined hand and power feed planer and variety moulder, by Messrs. Thomas Robinson & Son, Limited, Rochdale. The main frame of this machine is a cored casting with superposed tables, upon which is performed the operation of planing to thickness and surfacing, also jointing, chamfering, stop-chamfering, beading and rebating. The cutter block is extended over the side of the machine, and fitted with an overhanging cutter block, and rising and falling table, which table can be raised so as to carry the works above the cutter block for tonguing and grooving and beading, or lowered below the cutter block for thicknessing and making straight mouldings. It is fitted with continuous roller feed adapted for working mouldings up to 5 in. wide by 3 in. thick. The feed motion is driven by cone pulleys, so that the rate of speed can be varied. The machines are operated from line shafting, installed below the floor, as is also the 9-h.p. motor which drives the line shafting. The foundry, pattern shop and yard are electrically lighted, power for the various motors and current for lighting being taken from the local supply company.

A Special Plate Moulding Machine.

The illustration depicts a special plate moulding machine for repetition foundry work. The machine consists of two vertical columns resting on a bed-plate, the distance between these columns being capable of adjustment according to the size of the pattern plate. In the columns are two spindles which carry the pattern plate in bearings. These spindles are telescoped up and down the columns by means of a hand lever. The pattern plate can be turned completely round in its bearings, and underneath is a table running on rollers. The moulding boxes can be firmly attached to the pattern plate by means of collars or wing bolts.



SPECIAL PLATE MOULDING MACHINE.

In operating the machine, the bottom box is first fixed to the plate and the sand rammed up; the whole is then turned completely over and the box lowered until it rests upon the table. The plate is then unfastened from the box and fixed in its bearings by the set screws in the top of the column, and by means of the hand lever raised from the mould. At the same time, it should be given a few gentle raps as it leaves the sand, to prevent any clogging. The bottom box is now ready. The process of moulding the top is exactly the same as for the bottom, taking, of course, the impression from the other side of the plate.

The accurate perpendicular lift prevents the breaking off of the corners or the cracking of the sand, thus completely avoiding the troublesome application of water and the mending up of the mould. The spindle and bearings are completely encased and protected from sand.

The lift is so steady that but little taper is required in the pattern, and this is especially advantageous where a deep lift is necessary; moreover, the pattern cannot be rapped sideways when leaving the mould, and so increase the size or thickness.

The makers of the machine, Messrs. Samuelson & Company, Limited, Banbury, claim that it is a very efficient machine for rapidly producing work without the aid of highly-skilled labour.

Correspondence Instruction.

There is a certain amount of interest attached to every scheme of education, and particularly interesting to the worker who has only a few spare hours in which to study is such a scheme of instruction as we have before us. Instruction by correspondence is by no means a new departure, but until recent years it has been confined to more or less classical attainments; certainly it has seldom invaded the realm of engineering practice and similar fields. But among the subjects which are now being taught on the system of correspondence instruction by the International Correspondence Schools, Kingsway, London, W.C., there are a number which are purely for those engaged in the actual work day-by-day. The complete shop practical course embraces the practice of engineering and other shops, and includes the foundry, which section of the course we are particularly concerned with. Before proceeding further, however, it may be as well to explain the system upon which the courses are constructed. The whole scheme is apparently based on the presumption that everything taught in an instruction class can be equally well stated in print, and that properly condensed and arranged statements of facts can be readily assimilated by the student from hand-books or papers. Text-books are, of course, a feature of the technical schools where personal instruction is given by qualified teachers, and they are recognised as a necessity. Theoretically, then, it only becomes necessary to embody in the text-book the whole of the instruction to be given and to present it there in a clear and readily understood manner, for the student to be able to study in any spare time he may have, regardless of the convenience of the teacher, and regardless of stated class hours. This has been the idea on which the courses referred to have been arranged. The difficulty of checking whether the student has properly learned the subject in its various stages is met by his answering (by correspondence) a series of questions designed to thoroughly test his comprehension of the previous instruction, and until he has so proved his knowledge he is not passed on to the further lessons. These questions are all such as can be answered by a thorough study of the text-books which form the instructional part of the course. Individual difficulties which occur with individual students are thus treated in a direct manner and given separate attention, and by this means, it is claimed, the student should finish his course with a thorough knowledge of what has been placed before him.

So far, so good. The question which next arises is, "Do the text-books which are employed embody all the information which can be given in a good technical class with a competent instructor?" This is the question which we have now to deal with. We have before us the books in question, numbering about 20 papers in all. First are four dealing with green-sand moulding. These differ from ordinary books on foundry practice, in that they start with the presumption that the student is quite a beginner in the foundry and needs instructing in the numerous points of ordinary practice. Following on these lines the moulder's equipment is described, and then the whole process of green-sand moulding. The subjects are well explained and illustrated, and even the uninitiated should have no trouble in understanding. There seems scarcely a single point of general practice that is not explained, though there is an absence of the descriptions of moulding for specific jobs which often characterise foundry text-books. Having thus fully described the principles and operations of green-sand moulding, loam and dry-sand work do not need so fully treating. The essential points are, however, well brought out in the description, and the subject clearly explained. The paper on core-making is clear and instructive, as also is the one on rammers and moulding machines. Coming now to that paper which deals with cupola practice, we find that this subject is treated in a clear, methodical way, and cupola practice as a whole is explained in a very practical and useful manner. To qualify this commendation by stating that some points might have been more fully dealt with is really to acknowledge that there is much in cupola working that can best and often only—be taught by experience; this paper is, at any rate, full of valuable facts and instruction. At the end of it air-furnaces and oil furnaces are briefly dealt with.

Of considerable interest also are the three papers on malleable casting, for the process and the apparatus employed are clearly set forth and described. We have seen other books and papers treating more fully, particularly from a scientific standpoint, with some of the different phases of this subject, but here we have a clear, though condensed, description of the production of malleable castings from pig-iron to finished article. The two papers on foundry appliances give general instructions on the lay-out of a foundry and then proceed to deal with a considerable number of modern appliances. These papers appear well up-to-date, for much of the apparatus described represents quite the latest innovations in foundry equipment.

The paper on brass founding is, perhaps, somewhat disappointing, for in places the information given is only very general, and often very meagre. We should not be surprised to find this paper extended considerably in the near future. However, the fact that the other papers on moulding for iron castings are largely applicable to brass work, and thus cover the ground to a great extent, may create this impression of meagreness. A useful knowledge of measuring instruments will be obtained from the paper on that subject, while the one on the reading of working drawings should assist greatly in this important branch of a foundry worker's duties.

Taking this instruction course as a whole, we should say that it is very commendable. It may suffer somewhat through forming one section of a larger course, embracing complete shop practice, but it does what some systems of instruction do not; it insists on the student thoroughly mastering a defined —even though broadly limited—amount of teaching on the subject, and ensures, as it progresses, that no point has been skipped from any cause. This means that the student of average intelligence acquires a solid groundwork of foundry knowledge. If he wants to study more fully the scientific or technical sides of his trade he is still at liberty to attend the technical schools, which in many respects touch different ground; studying at either does not preclude studying at the other. In fact, we should suggest that this combined method of taking up the subject of education would prove very satisfactory.

We have received from Messrs. Alldays & Onions Pneumatic Engineering Company, Limited, Great Western Works, Birmingham, a copy of their new blower list, describing and illustrating their "Climax," Roots blowers and "Empire" pressure blowers. In addition to showing several excellent examples of these apparatus, suitable for all kinds of work, there are also shown exhausters and ventilators for shop uses.

Suggested Conciliation in the Brass Trade.

The interest which has been revived recently concerning alleged sweating in the brass trade, may possibly culminate in the revival of the Conciliation Board, in a more effective form than that of the board which was disbanded in 1907. Neither employers nor workers have committed themselves positively, but both seem inclined to welcome a reconstituted Board of Conciliation on broader lines than the first. It is pointed out that, apart from the question of wages, it would enable many minor differences between employers and workmen to be adjusted. For nearly forty years the brass workers have had a well-organised Trade Union, and in the face of this it would appear almost extraordinary that sweating should exist. But it is stated to be due in a great measure to the peculiar conditions of the trade. Before 1872 there was no Unionism in the brass trades excepting a couple of small sectional societies. Thirty-seven years ago 5,000 of the brass workers established a Union with the object of securing higher wages, and obtained a bonus of 15 per cent. In the absence of Trades Unionism the conditions of work had become very remarkable. It is stated that there were sub-contractors employing as many as 40, 60, or 80 men, and receiving large sums of money, out of which the underhands, many of whom were middle-aged men, were receiving no more than 14s. or 16s. a week each. It is explained that the society could not grapple with the whole question of sub-contracting, but they protested against the system. One consequence was a greater sub-division of the "shops," one man being put over six, eight, or ten other men. A great improvement was thus effected, but it left the conditions of labour still greatly different from those in other trades. On behalf of the Brassworkers' Society it is stated they have had to aim at a gradual reduction of the number of hands working for other operatives. In 1900 the Society proposed that only one workman should be employed by another, but this met with no favour from the manufacturers, and the arbitrator who was called in decided against the Society. Apart from this aspect of the matter, the brass trade has been adversely affected by various industrial changes and the introduction of labour-saving appliances, which have permitted the employment of women and boys. Men suffering from these conditions are naturally inclined to accept reduced piece-work prices and low wages rather than lose their employment. As a result of a variety of causes a large number of men employed as under-hands by the piece-worker or sub-contractor, are receiving poor wages, and the aim of the Brassworkers' Society is to obtain an advance of a halfpenny per hour for the men over 21 years of age whose earnings are now less than 28s. per week. It is intended eventually to raise the weekly wage of these men to a minimum of 28s. Under the system by which a sub-contractor bargains with and pays the under-hands it is obvious that an increase in the wages of the latter implies an advance in the prices paid to the piece-worker. It is urged, however, that an advance of a halfpenny per hour would not involve a heavy tax on the manufacturer, and that an increase of 2 per cent. on present prices to the journeyman would meet the difficulty. In some concerns the proportion of the group earnings due to the under-men is paid to them directly from the office, and many employers, as well as the bulk of the workmen, would like to see this system generally adopted. The main difficulty seems to be in regard to the smaller firms, and it is in respect of these that the allegations of sweating are more particularly made. One prominent manufacturer has, however, denied that sweating in the commonly accepted sense existed in the brass trade, and urged that the question was really one to be settled by the members of the Brassworkers' Society in relation to the under-hands. There was a minimum wage of 20s. 3d. for fifty-four hours, with a bonus of 20 per cent. for the male worker of twenty-one, and if that minimum were paid there could be no question of sweating in its real sense. If a man did not get that wage it was for the Trade Union to see that he did get it. Unless the under-hand receives his wages from the office the employer cannot be certain that he is being properly paid, and therefore the masters advocate payment from the office in order to stop the actual sweating of the under-men by the piece-worker. It is understood that the employers are quite open to further the suppression of sweating, and that they would welcome the establishment of a Conciliation Board.

Queries.

Cast Iron Gas Retorts.

Can any subscriber give the formula for casting gas retorts? Retorts cast in India, I find, do not compare at all favourably with those received from England.

"W. A. G.," India.

Cupola Particulars.

We are about to lay down a pair of new cupolas, to bring down from six to eight tons of metal per hour, and would like to have some information as to diameter of furnace and tuyeres, different heights from bottom to tuyeres, from tuyeres to charging hole, from charging hole to top of furnace, necessary amount of horse-power and size of blowers.

"H. L. F. C."

F.T.J. Bookshelf.

DER GRAPHIT; EINE TECHNISCHE MONOGRAPHIE. By Ingenieur A. Haenig. Vienna and Leipzig: A. Hartleben's Verlag.

We have received this interesting volume on graphite and its applications. It treats from a technical standpoint the production and application of this material under the following heads:—The nature and uses; formation and origin of deposits; the occurrence of graphite, and the winning, preparation and purification of graphite; the valuation and examination of graphite; the production, the manufacture and application of the material. The book presents a heap of valuable information, and is written from the standpoint of one who thoroughly understands his subject. A number of illustrations accompany the text, making in all a very useful little volume.

GATEHOUSE COPPER COMPANY, LIMITED.—Capital £15,000 in £1 shares, to acquire the Gategill Estate, Gatehouse-on-Fleet, and to develop the minerals. Registered office: 62, Robertson Street, Glasgow.

IT is reported that the Director of Naval Ordnance, Rear-Admiral Reginald H. S. Bacon, is about to retire from active service, to become the managing director of the Coventry Ordnance Works, Limited. Rear-Admiral Bacon is now in his 47th year, and has held the position of Director of Naval Ordnance since August, 1907.

Inventions.

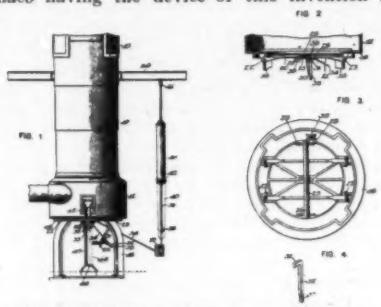
Applications for Patents.

An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

21,966. Furnaces. W. R. Wills, 203, Abbeyfield Road, Pitsmoor, Sheffield.
22,067. Manufacture or casting of iron, steel, etc. J. E. Bennett, 4, Corporation Street, Manchester.
22,201. Manufacture of iron and steel. B. Talbot.
22,426. Method of making alloys. T. D. Kelly, 11, Kitchener Road, Upton Lane, Forest Gate, London.
23,857.*Production of moulds. M. Küller.
24,068. Sweep for sweeping cores in foundry work. F. Falconer, 100, Wellington Street, Glasgow.
24,228. Gaseous fuel-heated furnaces, muffles, hearths, etc. Alldays & Onions Pneumatic Engineering Company, Limited, and F. W. Farmer, 35, Temple Row, Birmingham.
24,302.*Electric induction furnace. (Albert Hiorth, Norway.
24,697. Electrodes for electric furnaces. L. Ruthenburg.
24,739. Firebars and the method of and means for casting them in chills. D. Brown, 37, Moorfields, Liverpool.
24,833.*Machines for forming nut blanks. (American Car and Foundry Company, United States.)
24,839.*Processes of refining metals. J. H. Reid, 57, Lincoln's Inn Fields, London.
24,923. Alloy. J. F. Duke.
25,018. Process for obtaining an improved gas for metallurgical purposes. A. Graf and F. W. Smyth, 18, Pollards Hill North, Norbury, London.
25,128. Foundry moulding machines. A. P. Smith.
25,134.*Sand-blast machines. (William John Smith, United States.)
25,237.*Moulding and casting apparatus. C. W. King.
25,732. Manufacture of cast-metal chains. A. J. Holloway, Evenley, Ruislip, Middlesex.
25,914.*Casting machines. F. H. Howard.
26,251.*Electric furnaces. J. Härdén.
26,257. Manufacture of ingots of steel or steel alloy for use in the production of articles requiring hard wearing faces and soft or tough backing. F. E. Matthews, C. A. Pim, and E. H. Strange.
26,266.*Electric furnaces. J. Härdén.
26,588.*Process of refining steel. Société Anonyme Electrometallurgique (Procédés Paul Girod).
26,844.*Electric furnaces. A. Helfenstein.
26,845.*Electric furnaces. A. Helfenstein.
26,908.*Vacuum casting metal in a mould. P. Réal.
27,003.* Process of refining steel. Société Anonyme Electrometallurgique (Procédés Paul Girod).

Abstracts of British Patent Specifications recently accepted.

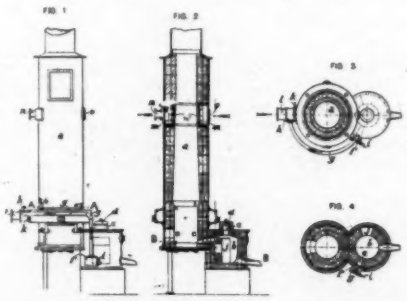
11,818 (1909). *Bottom Dumping or Discharging Doors for Furnaces or Cupolas.* J. Hyslop, Harvey, County of Cook, Illinois, U.S.A.—This invention relates to mechanism for closing and holding in place the bottom or dumping doors of a furnace or cupola such as is used in iron foundries and other places where the melting of iron and steel is required. The usefulness of the invention will be more apparent when it is remembered that the opening closed by these doors is frequently 6 or 8 ft. in diameter and that the doors are made of a couple of inches of thick cast iron, and located at such a height that a man may freely walk under the furnace bottom of which the doors form a part. The invention consists in a power-operated mechanism which engages each door at some distance below its normal plane, so that the door is firmly moved into and temporarily held in finished position, and it also consists in mechanism by means of which the lifting mechanism may be readily attached and detached from the bottom of the door. Fig. 1, is a front elevation of a foundry cupola or furnace having the device of this invention applied



Hyslop's Bottom Dumping or Discharging Doors for Furnaces or Cupolas.

thereto; Fig. 2 is a sectional detail view through the bottom doors; Fig. 3 is an inverted bottom view of the cupola showing the doors; Fig. 4 is a detail view of a detachable post by which the lifting mechanism proper is attached to the door.

22,082 (1908). *Smelting Furnaces.* Société Anonyme d'Exploitation des Brevets Cubilot A. Baillot, 22, rue d'Athènes, Paris.—The present invention relates to a smelting furnace with a fore-hearth having a heating device, being particularly adapted for the production of cast iron. This smelting furnace is characterised by the fore-hearth having a chimney with removable lid, arranged in combination with a device for deviating part of the blast to be conducted to the fore-hearth for increasing the temperature in the same by the combustion of the fuel which has been charged into the fore-hearth at the beginning of the operation, and which is completely consumed before metal flows into the fore-hearth, and further in combination with a device below the furnace top for heating the air, the latter device utilising the waste heat of the furnace. The air is drawn in by the fan and afterwards forced into the

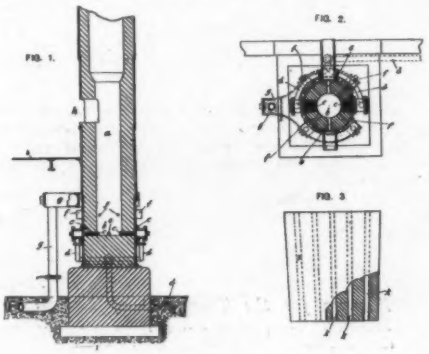


Smelting Furnace, by Soc. Anon. D'Exploitation des Brevets Cubilot A. Baillot.

blast pipes of the furnace. The fore-hearth is heated at the beginning of the operation only, so that the pig-iron completes its fusion in a chamber where it is completely separated from the fuel, whereby a more complete decarburisation is realised, which is particularly adapted for the production of certain pig-irons. The fuel for heating the fore-hearth has been consumed before the metal in fusion flows into it from the furnace. Fig. 1 represents an elevation of the furnace showing the blast pipe for the fore-hearth; Fig. 2 is a

vertical section of the furnace representing the heating chamber for the blast air and the fore-hearth; Fig. 3 is a horizontal section on line A—A of Fig. 1, representing in ground plan the blast pipe for the fore-hearth; Fig. 4 is a horizontal section on line B—B of Fig. 2, representing the blast-inlet for the fore-hearth.

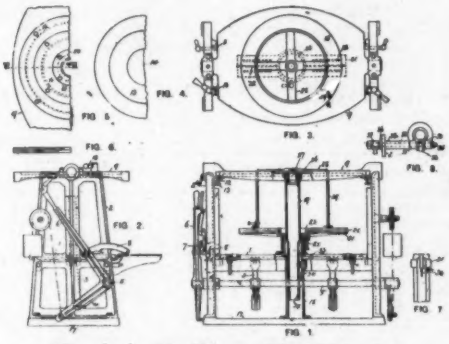
22,948 (1908). *Process for Melting and Refining Iron and Apparatus therefor.* H. Johnson, Church Lane, Saxilby, Lincoln.—The main body of air is forced through the molten metal at the bottom of a cupola and the burning gases given off are utilised to heat and melt the descending charges of iron. A cupola constructed according to the invention may be designed as follows:—The cupola, which may be of the ordinary type, with or without a receiver, is formed with a bath at the bottom capable of holding a suitable quantity of molten metal. A set of high-pressure blast tuyeres are provided in the side walls at the bottom of the bath, the size and number being governed by the melting capacity of the cupola, the tuyeres being connected to



Johnson's Process for Melting and Refining Iron.

a suitable air compressor or pressure blower, and serve to refine the metal. The bottom of the bath may be formed with a tapping hole through which the metal remaining at the end of a blow may be run off, and at the top of the bath an overflow may be provided which may be connected to a receiver or be used as the outlet to the ladle. A set of tuyeres are provided at a higher level than the blast tuyeres and are connected to a suitable fan or blower, these low-pressure tuyeres being approximately at the same level as the overflow. Preferably, the charging door is arranged at a suitable height so as to secure and utilise the maximum heat from the burning gases as they pass from the bath through the charge to the atmosphere. Fig. 1 is a vertical section; Fig. 2 is a horizontal section; and Fig. 3 is a sectional plan of one of the air bricks.

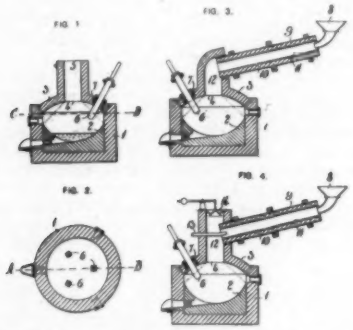
1,637 (1909). *Foundry Moulding Machines.* R. Carrick, 14, Norwood Road, Shipley; and H. E. Kitchen, 8, Glynn Terrace, Thornton Road, Bradford.—This invention relates to improvements in moulding machines whereby the one machine is rendered capable of moulding by the "turn-over" method and the "stripping," method, and, at the same time, capable of being easily adapted to make pulley and similar moulds necessitating an inside and outside stripping action. The machine is provided with a vertically rising and falling platform guided in the main frame, which platform is raised and lowered by means of depending links connected to cranks on a horizontal shaft mounted in the frame under the platform. This shaft is turned or operated by means of a long hand-lever, provided with a spring-operated pawl or catch, which works over a graduated and toothed segment or guide, so that the handle and, therefore, the platform, is capable of being locked in different positions at various fixed heights say one-half inch apart. Above the platform is mounted a pivotal table bearing in the main frame and capable of being securely locked in its horizontal position by suitable catches, such as pivotally mounted fingers, capable of being turned and embracing both the upper and lower sides of the table. Additional securing means, such as screw-threaded fingers mounted in the main frame and capable of engaging in recesses in the sides of the table may also be employed. Stops are provided on the main frame with upstanding thumb screws, screwing therein, to enable the table to be adjusted so as to be absolutely horizontal. This table is provided with, or consists of an outside pivotally mounted frame and an inner circular or centre piece with concentric annular pieces or rings between the frame and centre piece, so that an orifice may be formed in the table when required of a size varying with the number of rings removed. The rings and centre piece are all capable of being secured rigidly to the table by bolts and nuts or other means. In the machine concentric with the centre piece of the table, and resting on the bed-plate of the machine, is a base into which a removable pillar can be fixed. There is a corresponding hole or orifice in the platform. In moulding by the "turn-over" method the patterns are fixed by clamps on the table and the usual flask or moulding box is placed on the pattern, clamped to the table and then rammed. The table is turned over and the platform raised up to support the flask while the same is unclamped. When this is completed the platform is lowered and the flask removed therefrom, and if need be the operation repeated. In stripping-plate work, however, the centre piece of the table, and, if



Foundry Moulding Machine, by Carrick & Kitchen.

required by the size of the mould to be made, one or more of the rings are removed from the table, and a ring having its inside contour corresponding to the outside contour of the pattern substituted therefor. The pattern is mounted on an adjustable bed temporarily secured to the platform. The adjustable bed is provided with undercut slots and corresponding clamps for securing the pattern thereto while in addition or as an alternative the bed is provided with a central split bush, which can receive a wooden or other boss on the pattern if desired. This bed itself is provided with a telescopic or adjustable support capable of being clamped in position. The flask is placed on the table over the orifice, then the pattern raised up through the orifice to the desired extent and the flask then packed and rammed. When this is accomplished the pattern is lowered and the flask with the mould removed from the table. Fig. 1 is a front elevation of a moulding machine in accordance with the present invention partially in section; Fig. 2 is an end view of Fig. 1; Fig. 3 is a plan view of Fig. 1; Fig. 4 is a plan view of a portion of the table shown in Figs. 1, 2, and 3, arranged for "turn-over" work; Fig. 5 is a similar view to Fig. 4 arranged for "stripping plate" work; Fig. 6 is a section taken through the line VI—VI of Fig. 5; Fig. 7 is a detailed view of the base in which the central pillars shown in Fig. 1 are mounted; Fig. 8 is a plan view of Figure 7 showing in addition the means for actuating the pinion mounted in the base for raising and lowering the central pillar.

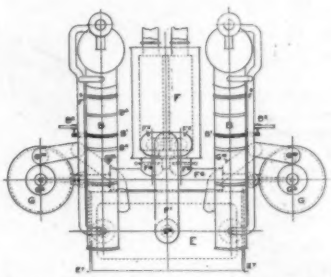
4,553 (1909). *Electric Furnace.* Aktiebolaget Elektrometall, 43, Bergsgatan, Stockholm, Sweden.—The present invention relates to that type of electric furnace for smelting and reducing ores, which is fed from a central shaft leading into a cupola, so arranged that on its being charged one or more free spaces always arise between the charge and the brickwork in the upper part of the furnace, and in which the electrodes, which are introduced into the upper part of the furnace, are put into contact with the charge (*i.e.*, the material to be treated), serving as resistance mass at that or those places where the material does not touch the brickwork. In such furnace the electrodes were arranged vertically near to the corners or at the sides, and extended close to the bottom of the furnace; consequently, the brickwork, especially at the corners or



Electric Furnace, by Aktiebolaget Elektrometall.

sides, received the effect of the high pressure. In another type of furnace, which was fed by side shoots leading the material to the bottom of the furnace or by passages made between the electrodes, these latter were arranged obliquely and the current passed through the mass to a metal plate carried in the bottom of the furnace; therefore, the walls of the furnace likewise received the effect of the high temperature. The object of the present invention is to overcome this inconvenience. The electrodes are arranged obliquely through the bottom of the furnace, the result being that the development of heat takes place within the mass of material and not in the immediate proximity of the walls. Fig. 1 is a vertical section drawn on the line A—B in Fig. 2, which is a horizontal section drawn on the line C—D in Fig. 1, of a furnace constructed in accordance with the invention. Figs. 3 and 4 show vertical sections of two other forms of construction of the invention in question.

22,412 (1908). *Furnaces for the Treatment of Metals, Metallic Ores and Alloys.* E. T. Fennell, 5 and 6, Church Street, Woolwich, Kent; and J. Sackett, 11, Woodland Terrace, Charlton, Kent.—This invention relates to furnaces of the type wherein metals are first reduced in a rotating conveyor cylinder arranged between an inclined feeding chute and a second chute leading to a regenerative open-hearth furnace, in which, during the metallurgical operation, a bath of metal is maintained in a molten state. The annexed cut is a plan view of a furnace comprising gas producers, regenerators, and their accessories constructed in accordance with the invention. The heated ferruginous ore after leaving the shoots, enters the revolving de-oxidising refractory lined conveyor cylinders B, which are rotated by means of toothed bands B^1 gearing with pinions B^2, which latter are carried upon rotatable shafts. The cylinders B are supported upon rollers B^3 upon which loops B^4 engage or run. The cylinders B are connected at each end with angle iron collar connections B^5, the whole being suitably supported above the regenerator F and cylindrical hearth E by means of girders B^6 carried on columns B^7 standing on and fixed to concrete foundations B^8. The mixtures of ore, flux and fuel are conveyed to the exit ends of cylinders B where the now de-oxidised ores come in contact with a further supply of carbon from regulated feed hoppers communicating with the stationary cylinders, wherein are also inserted valved air supply pipes, provided with internally situated valved oil supply pipes for the purpose of supplying a highly heated carbonising flame, which may serve to fire the hearth E or assist in so doing. The de-oxidising and carburised metallic particles pass down the fusing shoot into the molten and slag bath in the main cylindrical hearth E. The molten pig-metal thus produced is then removed from the furnace from time to time—care being taken to always leave a bath of molten metal and slag for the reduced metal to fall into—for conversion into wrought iron and steel. The main hearth E is fed at each end from the vertical fusing shoots through the passages between the refractory depending baffle or curtain and the circular ends of the cylindrical hearth. This hearth E is fired by the burner or by means of highly heated air discharged from the refractory lined pipes communicating with the regenerators F, and gas supplied through the pipes communicating with the producers G. The heated air and



Furnace for the Treatment of Metals, Metallic Ores, and Alloys, by Fennell & Sackett

gas orifices are cut in the refractory lining at such angles that the products of combustion formed by the air and gas strike the opposite side of the refractory lining at an angle, and set up a series of revolutions before finally escaping by way of outlets E^6 to each of the regenerators alternately. The lateral expansion of the hearth is taken up by the springs of the bolts E^7. The gases escaping from hearth E pass out by way of the outlets E^6 to each of the regenerators alternately through the main escape pipe F^1 which is connected to valved pipes F^2. The cooled gases escape from the regenerator by way of the valved outlet pipe F^3. The cold air inlet is supplied with air preferably above atmospheric pressure which travels through heated chequer brickwork within the regenerator and leaves by way of refractory lined valved pipes F^5 to the main heated air refractory lined branch pipe F^6 which has connected with it the take-off pipes and the end take-off refractory lined pipes F^7 which are connected to similar pipes F^8 for supplying heated air to the shoots and stationary cylinders. The pipes F^7 are also connected to pipes G^1 for supplying heated air to suitable gas producers G.

We are informed that, owing to the pressure of his engagements, Sir Edward Grey found himself unable to appoint a day for the Dale Memorial Lecture which he undertook to deliver during last month. It is hoped that a date in the spring, probably shortly before Easter, will be appointed. The Sir David Dale Memorial Lectures, of which the one to which reference is made above is the first, are to be delivered from time to time in various towns in the North of England, and will deal mainly with the relations of employers and employed. The late Sir David Dale, it will be remembered, was a great advocate of arbitration and conciliation in trade disputes.

Trade Talk.

ALFRED HERBERT, LIMITED, of Coventry, have established an office in Berlin.

MESSRS. M. P. MUNTZ, of the Alexandra Works, Tipton, are making extensions to their works.

THE London office of the Falkirk Iron Company has been removed to Craven House, Kingsway, London, W.C.

MESSRS. H. & T. LEIGHTON, engineers and machinery brokers, Pensnett, Dudley, Staffs., have opened a branch office at Dudley Port.

THE ELECTRICAL APPARATUS COMPANY, LIMITED, of Queen's Road, Battersea, are making considerable extensions to their works.

THE LANCASHIRE DYNAMO AND MOTOR COMPANY, LIMITED, have established an office at 109, Peterkin Building', Toronto, Canada.

THE FERRYBRIDGE FOUNDRY COMPANY, of Ferrybridge, Yorks., have established a London branch at 12 and 13, Henrietta Street, Covent Garden, W.C.

MESSRS. H. LACY and P. C. MIDDLETON, engineers, Eccleston Place, London, S.W., trading under the style of Lacy & Company, have dissolved partnership.

MR. G. F. PREST has been elected to a seat on the board of the Parsons Marine Steam Turbine Company, Limited, in place of the late Mr. N. C. Cookson.

MAWDSLEY'S, LIMITED, of Dursley, have appointed Mr. S. M. Jones, Western Mail Chambers, Cardiff, and Wind Street, Swansea, as their sole Welsh agent.

MR. S. P. FRASER, Broad Street House, New Broad Street, London, E.C., has been appointed London agent of the Arkwright Foundry Company, of Nottingham.

SIEMENS BROTHERS DYNAMO WORKS, LIMITED, of Caxton House, Westminster, London, S.W., have removed their Supplies Department to 39, Upper Thames Street, London, E.C.

THE DENBIGH ENGINEERING COMPANY, Horseley Heath, Tipton, Staffs., are making extensions to their machine shop for the manufacture of punching and shearing machines, fans, blowers, etc.

MESSRS. HENRY PELS & COMPANY, of Lincoln Chambers, 9, Portsmouth Street, Lincoln's Inn Fields, London, W.C. have opened a branch office at 148, Rue Terre Neuve, Bruxelles, Belgium.

MESSRS. W. J. NEWALL and J. H. HINCHLEY, consulting engineers, Gracechurch Street, London, E.C., who traded under the style of Newall & Hinchley, have notified a dissolution of partnership.

MR. JUSTICE SWINFEN EADY, in the Companies (Winding-up) Court, on November 23, made a compulsory order for the winding-up of the British Combined Metals Manufacturing (Parent) Company, Limited.

MESSRS. HASLAM & SCHONTHEIL of Western Mail Chambers, Cardiff, have been appointed representatives for South Wales for the Steamcubator Engineering Company, of 30, Cross Street, Manchester.

MR. H. SPANNAGEL, of Broad Street House, New Broad Street, London, E.C., has been appointed sole London representative of the Humboldt Engineering Works Company in place of Mr. H. Mackay.

THE following machine tools and parts can now be imported into Australia free of duty:—For metal working: Saw-setters (automatic) for setting band saws. For wood working: Wire bound box-making.

A DISSOLUTION of partnership is notified in connection with Messrs. I. E. Cassell and G. B. Shepherd, consulting engineers, etc., Chancery Lane, London, W.C., who traded under the style of Cassell & Company.

MR. W. H. BODIN has resigned his position as managing director of W. H. Bodin & Company, Limited, engineers, etc., Acme Works, Darlaston. Mr. E. O. Fellows has been appointed manager of the company.

MESSRS. G. DUNN, G. GOODER, AND G. H. PENNETT, general millwright engineers, Dewsbury, Yorkshire, trading under the style of George Dunn & Company, have dissolved partnership so far as regards Mr. G. Gooder.

THE Engineering Employers' Federation has arranged to remove its headquarters from Glasgow to London, and will early in January enter into possession of offices at 24, Abingdon Street, Westminster, London, S.W.,

THE COVENTRY ORDNANCE WORKS, LIMITED, have established branch works on the Clyde. The manufacture of gun-mountings for warships has been commenced, an extensive order having recently been placed with the firm.

CANDIDATES for the Andrew Carnegie Research Scholarship of the Iron and Steel Institute, who must be under thirty-five years of age, must apply on a special form before the end of February next to the secretary of the Institute.

THE partners in Messrs. Cartwright, Parsons & Company, Newton Tube, Fitting and Engineering Works, Cradley Heath, Staffs., are dissolving partnership, and the whole of the works plant, fittings, and stock have been sold by auction.

MR. A. BURNSTINE has been appointed agent for the Warner Engineering Company, Limited, in the Argentine, Uruguay and Paraguay, with offices at 425, Maipu, Buenos Ayres. The company have also opened an office at 2, Rector Street, New York, U.S.A.

THE WORKINGTON IRON AND STEEL COMPANY, LIMITED, are closing their Moss Bay Works at Workington for some weeks to enable important works of development and reconstruction to be carried out. The Derwent Works are to be similarly dealt with.

THE business of Messrs. John Wallace & Company, Barrhead Boiler Works, Barrhead, has been transferred by the trustees of the late Mr. John Wallace to Messrs. J. & R. M. Wallace, sons of the deceased gentleman, who will continue the business under the same name.

WE are informed that Thomas Firth & Sons, Limited, of the Norfolk Works, Saville Street East, Sheffield, have appointed Messrs. Scales, McMillan & Daggar, 13, Macquarie Place, Sydney, N.S.W., as their sole representatives for the Eastern States of the Commonwealth.

MESSRS. W. J. KROGSDAL & COMPANY, 4, Lloyd's Avenue, Fenchurch Street, London, E.C., have been appointed sole agents of Sieg-Rheinische Huetten-Aktien-Gesellschaft, Friedrich Wilhelmshuette ad. Sieg, for the United Kingdom for the sale of strips for tube making.

MR. W. H. HERDSMAN has acquired from Mr. A. Campion his business of an analytical and consulting chemist and metallurgist at 144, Wellington Street, Glasgow. Mr. Campion has been appointed head of the metallurgical department of the Glasgow Technical College.

WILLIAM BAIN & COMPANY, LIMITED, of the Lochrin Iron Works, Coatbridge, celebrated their jubilee on November 19th, when the employés were entertained by the directors. The business was established in Edinburgh, in 1859, and converted into a limited liability company in 1908.

THE discharge from bankruptcy of Mr. A. L. Young, carrying on business under the style of Young, Bowson & Company, College Court, Hammersmith, W., and Emmett Street, Poplar, E., copper founder and nail manufacturer, has been suspended for three years, ending October 26, 1912.

HAVING relinquished the agency of the Nurenberg Works, by mutual arrangement since May of this year, Mr. James Halcrow, of 18, Coleman Street, London, E.C., has now taken up the agency for the sale of large gas engines manufactured by Messrs. Thyssen & Company, Mulheim-on-the-Ruhr.

J. DAMPNEY & COMPANY, LIMITED, of Post Office Chambers, Cardiff, manufacturers of the "Apexior" compound for preventing incrustation and corrosion in steam boilers, are this week removing to the Merchants' Exchange, Cardiff, where they have secured more extensive and commodious offices.

THE prospectus has just been issued of the Engineering and Machinery Exhibition (organised by "The Engineering Review"), to be held in Manchester, from

October 14 to November 5, 1910. The Exhibition director is Mr. C. H. Luke, A.I.E.S., and the offices are at 16, John Dalton Street, Manchester.

THE shareholders of the Griffin Iron Works Company, Limited, have decided to wind-up the company, Mr. S. J. Short, 88, Albert Road, Handsworth, the secretary of the company, having been appointed liquidator. A meeting of the creditors will take place at the Ladywood Foundry, Browning Street, Birmingham.

DORMAN, LONG & COMPANY, LIMITED, of Middlesbrough, have secured the contract for the supply of the structural material required for the new wagon-building works which the Midland Railway Carriage and Wagon Company are about to erect at Washwood Heath, on the outskirts of Birmingham. The contract is reported to be worth £30,000.

WILLIAM BEARDMORE & COMPANY, LIMITED, of Glasgow, dispatched from their Parkhead Works to Woolwich Arsenal, recently, the first modern heavy gun that has ever been manufactured in Scotland. This gun is a 12-in., 50-calibre, and 68 tons in weight, and is intended for use on one of the most recent British battleships of the "Dreadnought" type.

OWING to increasing work in the engineering department, Markham & Company, Limited, of Chesterfield, have found it necessary to make a considerable extension to the erecting shop at the Broad Oaks Iron Works. They are also supplementing the crane equipment of this shop by the installation of a Craven electrically-driven overhead crane, with a lifting capacity of 40 tons.

MESSRS. NEWTON BROS., Market Place, Derby, are making considerable extensions to their works on the Alfreton Road, where they are installing a modern plant for the manufacture of electrical generators, pumps, motors, and gas producer plants. When these alterations are completed, the plant will be transferred from the works at the Market Place, which will then be used as offices only.

MR. D. STRATHIE, 162, St. Vincent Street, Glasgow, the liquidator of the Ardrossan Foundry Company, Limited (in liquidation), calls a meeting of the shareholders to be held within the liquidator's office on December 22, for the purpose of having an account laid before them, showing the manner in which the winding-up has been conducted, and the property of the company disposed of.

JULIAN KENNEDY, SAHLIN & COMPANY, LIMITED, of Brussels and London, have received a large repeat order for Morgan continuous gas producers from Thos. Firth & Sons, Limited, of Sheffield. Among other important producer plants now being erected by this firm is one for Steel, Pecch & Tozer, Limited, of Sheffield, this being the fourth batch of Morgan producers installed by the latter firm.

THE BRITISH AND COLONIAL HORSE SHOE AND MACHINE, COMPANY, LIMITED, of Billiter Buildings, Billiter Street, London, E.C., and the Globe Iron Works, Walsall, have purchased the whole of the assets of the United Horse Shoe and Nail Company, Limited, of Cubitt Town, London, E., including their horse nail works (Hastkosomfabriken United Horse Shoe and Nail Company), at Gothenburg, Sweden.

THE CHAIN BELT ENGINEERING COMPANY, Colombo Street, Derby, are erecting an extension at their works abutting on the railway. The new shop is 176 ft. long, and is covered by three bays, each 30 ft. wide. The whole of the ironwork used in the construction has been supplied by A. Handyside & Company, Limited, of Derby. When completed, the new shop will be laid out for the production of chain and conveyor work.

ASHWORTH, SON & COMPANY, LIMITED, of the Midland Iron Works, Dewsbury, have recently erected a new and commodious building equipped with the most up-to-date machine tools in order to keep pace with the increased demand for their weighing machines. The company have made a speciality of weighbridges for high-capacity railway wagons, and are meeting with a considerable amount of success in regard thereto.

THE advance prospectus of the Naval and Engineering Exhibition, which Mr. F. W. Bridges has arranged to organise in response to the suggestions of many who were associated with the Engineering Exhibitions of 1906 and 1907, has just been issued. The exhibition, which will be opened in September, 1910, is being divided into some classes, two of which are for metallurgy and casting.

THE BLAENAVON COMPANY, LIMITED, have recently arranged with Mr. P. J. Mitchell, of Westminster, London, S.W., for an exhaust steam turbine installation designed upon the Rateau patent. This installation is to consist of one Rateau patent mixed-pressure turbo blower of a capacity of 35,000 cubic feet of free air per minute of normal working-pressure of 14 lbs. per square inch.

MR. S. N. BRAYSHAW, of Manchester, maker of milling cutters, small tools, and hardening furnaces, is enlarging his works. The alterations include the provision of more room, both for storing and for building furnaces, also a loading way is being built to facilitate the rapid handling of the products of the works. The extensions now being made will enable him to increase the number of men employed, both on the day and night shifts.

EXTENSIVE building operations are in progress at the works of Alfred Hickman, Limited. A new power house is being erected, not so much to meet any present demand for energy, as a provision for future extensions. The hot bank over the new electrically-driven mill has also been extended. A piece of land adjoining the works on the canal side has been purchased, and is being levelled with a view to building mess-room accommodation for the employés.

H. R. CLEWS & SON, LIMITED has just been registered as a private company, with a capital of £1,000 in £1 shares, to carry on the business of manufacturers of and dealers in brass, copper, and other candlesticks and kettles, brassfounders, casters, stampers and piercers, metal workers, hardware manufacturers, etc. The subscribers are: E. C. G. Mountford, Small Heath, Birmingham; M. S. Mountford, Birmingham; and Miss K. L. Tearne, Solihull.

A MEETING of the shareholders of Ewing & Lawson, Limited, engineers, etc., Glasgow, was held on November 15, at Glasgow, when a resolution was passed to the effect that it had been proved to the satisfaction of the meeting that the company could not, by reason of its liabilities, continue its business, and that it was advisable to wind up the same, and accordingly that the company be wound up voluntarily. Mr. T. L. McLintock, 149, West George Street, Glasgow, was appointed liquidator.

A PETITION has been presented to the Sheriff of the county of Ayr, at Kilmarnock, at the instance of Cruikshank & Company, Limited, Denny Iron Works, Denny, for sequestration of the estates of the Walls Valve Manufacturing Company, makers of spring and deadweight safety valves, etc., Ardrossan, and Sheriff Mackenzie has granted warrant for citing the debtors to appear in court on the seventh day next after citation. Messrs. Wilson, Caldwell, Tait & Letham, 79, West Regent Street, Glasgow, are agents.

MR. JUSTICE SWINFEN EADY, in the Chancery Division, on November 23 sanctioned a scheme of arrangement proposed by the Aluminium Corporation, Limited, and the liquidators of the old company, whereby the whole of the assets were to be transferred to a new company upon the terms that the secured creditors would be paid in full in cash, as also the unsecured creditors under £10, and unsecured creditors over £10 would receive preference shares in the new company of the nominal value of their debts, and the shareholders would receive partly-paid shares.

IN view of the debate in the French Chamber on the proposed changes in the duties on steel, the British Chamber of Commerce in Paris has renewed its representations both against the proposed increased duty on high speed steel and the classification of steel according to percentage of tungsten or other alloy contained in it. It is pointed out that the question is most serious for British manufacturers, since classification by percentage of alloy would result in English disputes with the French Customs authorities, and would practically prohibit all imports.

NEARLY all the old buildings at the works of the Vulcan Foundry, Limited, Newton-le-Willows, Lancs., have now been superseded in pursuance of the general scheme of extension and reconstruction, which has proved to be admirably adapted to facilitate the operations of the company's business. The output from the works has been greater than in any preceding year, but there is at the present time a considerable depression in the trade. In response to the request of several of the local staff and foreman, 1,445 ordinary shares have been issued to them at par upon special conditions.

AT the Wolverhampton County Court, recently, the adjourned examination in bankruptcy took place of Thomas Pedley, iron and brass founder, of Somerford, Willenhall. An amended statement showed that instead of Mr. Pedley having an excess of assets over liabilities of £9,130 in November, 1907, there was an actual deficiency of £1,504, and the accountants were of opinion that that figure would be materially increased if it were possible to ascertain the exact position at that date. As it was, with the loss arising from the business and the personal expenses of the debtor, the final deficiency became £7,169, leaving the difference to be accounted for at £779. The examination was closed.

RALPH MARTINDALE & COMPANY, LIMITED, Crocodile Works, Alma Street, Aston, Birmingham, are making extensive alterations in the internal arrangements of their works, more particularly in the matter of prime movers. Hitherto the works have been operated partly by electric motors, current being taken from the Corporation mains, but in the main by a number of small steam engines. The electrical drive was installed by way of experiment, and has not, from an economic standpoint, proved wholly successful. So that, rather than increase the number of motors, or put down additional steam plant, the management have decided to remove the existing motors and steam engines, and replace them with an installation of gas engines. The first installation will consist of three Crossley engines of 189, 95, and 90 h.p. respectively, designed to work with the improved type of Dowson producers.

AMONG the new mayors this year are many well known in the iron, steel, and engineering industries. Mr. David Matthews, of Swansea, is a prominent metal merchant in the borough, establishing himself in business at the early age of 18 years; Mr. G. T. Grey, of South Shields, is a brassfounder, coppersmith, and engine maker, his works occupying a large area in West Holborn; Mr. W. Leitch, of Workington, was at one time secretary and manager of the Lowther Iron & Steel Company, but is now a stock- and share-broker; Mr. R. Nevison, of Thornaby, is associated with the firm of W. Whitwell & Company, Limited, of the Thornaby Iron Works; Mr. John Davies, of Cardigan, is manager of the Cardigan Engineering Works; Mr. M. C. James, of Jarrow, was 17 years ago made naval architect and surveyor to the Prince Line, and 12 years ago became manager to the Tyne Mercantile Dry Dock Company of Jarrow, of which he is now managing director. He is an active member of the North-East Coast Institution of Engineers and Shipbuilders.

AN interesting paper was read to the Coventry Engineering Society, recently, by Mr. George Hailstone, upon "The Work of an Iron Foundry Laboratory." Mr. Hailstone said there was no doubt that each year the work of the iron foundry laboratory was expanding, and was now even extending into the foundry itself. Not only must the man in charge of such a laboratory be an analytical chemist, but in addition, he must be a practical metallurgist, knowing something of actual foundry working. Chemical analysis must form the basis upon which to work in the mixing of iron for castings, but there were other factors which had to be taken into account to obtain satisfactory results, especially in the class of engineering that required exceptional physical qualities in the shape of high strengths and good wearing properties under severe conditions, such as motor parts, aeroplane, gas, oil, and steam-engine cylinders, etc. This demonstrated the absurdity of employing a man to mix iron by chemical analysis alone, because irons of identical chemical composition produced at different blast furnaces had widely different physical conditions or structures, and the true worth of any pig-iron in a mixture was dependent upon this physical condition, as well as its chemical composition where high strengths had to be obtained. The present generally accepted action of the usual metalloids, generally present in cast iron, was then briefly referred to, Mr. Hailstone insisting that pig-iron should be purchased to specification. There was no difficulty experienced in obtaining a selection of foundry irons, which, when mixed in proper proportions, would yield cast iron suitable for any class of castings. Each delivery of each brand of iron should be analysed to check the makers, as they were liable to make very big mistakes at times.

New Companies.

NUNEATON ENGINEERING COMPANY, LIMITED.—Capital £10,000 in £1 shares.

PLANT, LIMITED.—Capital £500 in £1 shares, to carry on the business of founders, engineers, etc.

MENNO LUBRICATOR COMPANY, LIMITED.—Capital £50,000 in £1 shares. Registered office: Broad Street Avenue, E.C.

MACHINERY, LIMITED.—Capital £10,000 in 5s. shares, to carry on the business of engineers, founders, etc. Registered office: Kingsway House, Kingsway, W.C.

HOUNSLOW ENGINEERING COMPANY, LIMITED.—Capital £1,000 in £1 shares, to carry on the business of engineers, etc. Registered office: 16, Finsbury Circus, E.C.

CROSS & CROSS, LIMITED.—Capital £2,000 in £1 shares, to take over the business of constructional and electrical engineers, carried on at Pleck Road, Walsall, as Cross & Cross.

A. A. RUPPRECHT & COMPANY, LIMITED.—Capital £1,000 in £1 shares, to carry on the business of mechanical, electrical, and general engineers, etc. Registered office: Carlton House, Regent Street, London, S.W.

DUGGANS, LIMITED.—Capital £5,000 in £1 shares, to acquire the undertaking of B. Duggan, at Henry Street, Coventry, and to carry on the business of malleable iron, gun-metal, aluminium, and other metal founders, etc.

E. SIDDAWAY & SONS, LIMITED.—Capital £10,000 in £1 shares, to take over the business of a gas-stove maker and general ironfounder carried on by E. Siddaway at Victoria Works, George Street, West Bromwich, as E. Siddaway & Sons.

WAKELIN BROS., LIMITED.—Capital £2,000 in £1 shares, to adopt an agreement with J. F. Wakelin, and to carry on the business of electrical, mechanical, and general engineers, etc., at 5 & 7, Tottenham Street, Tottenham Court Road, London, W.C.

HASLAM & SCHONTHEIL, LIMITED.—Capital £4,500 in £1 shares, to adopt an agreement with S. B. Haslam, T. Schontheil and A. C. Scott, and to carry on the business of engineers, etc. Registered office: Western Mail Chambers, St. Mary Street, Cardiff.

BRITISH STAMPING AND ENGINEERING COMPANY, LIMITED.—Capital £3,000 in £1 shares, to take over the business carried on by A. Cooper at the Cleveland Works, Tat Bank, Oldbury, Worcestershire, as the British Stamping and Engineering Company.

KNOTT & SMITH.—Ironfounders and specialists in fine art castings, Bloomsbury Street, Wolverhampton Partnership for 10 years from November 1, 1909. General partners, C. R. Smith, and A. B. Smith. Limited partner, Mrs. E. Smith, contributing £200 in cash.

WESTMINSTER TOOL AND ELECTRIC COMPANY, LIMITED.—Capital £1,000 in 500 "A" shares of £1 each and 10,000 "B" shares of 1s. each, to carry on the business of electrical engineers, etc. Registered office: Palace Chambers, Bridge Street, Westminster, S.W.

GEORGE BURN, LIMITED.—Capital £15,000 in £1 shares, to acquire the business carried on by the late G. Burn at Moland Street, Birmingham, and to carry on the business of dealers in brass, copper, and other tubes, etc. Registered office: 114, Moland Street, Birmingham.

TOWNSHEND'S ART METAL COMPANY, LIMITED.—Capital £6,000 in £1 shares, to acquire the business of Townshend's Art Metal Company, Limited, of Ernest Street, Birmingham, and 62, Holborn Viaduct, London, and to carry on the business of metal workers, brass founders, etc.

A. J. STEVENS & COMPANY, LIMITED.—Capital £1,000 in £1 shares, to take over the business of motor-engine and screw manufacturers, carried on by H. Stevens, G. Stevens, J. Stevens, jun., and A. J. Stevens, at Retreat Street, Wolverhampton, as A. J. Stevens & Company.

PATENT CASTINGS SYNDICATE, LIMITED.—Capital £6,300 in 6,000 ordinary shares of £1 each, and 6,000 deferred shares of 1s. each, to adopt an agreement with R. F. Krall and U. Owen, and to acquire inventions relating to castings, etc. Registered office: 46, London Wall, E.C.

TOWNSEND & PRICE, LIMITED.—Capital £8,000 in £1 shares (2,000 5 per cent. non-cumulative preference), to take over the business of engineers, etc., carried on by Townsend & Price, at Osborn Road, Weston, near Bath, and to adopt an agreement with C. Townsend and R. B. Price.

WILLIAM CORNS & SON, LIMITED.—Capital £10,000 in £10 shares, to take over the business of a manufacturer of mills, grinding machinery, tanks, cisterns, etc., formerly carried on by the late H. Pinson, and since his decease, by J. Pinson, at Snow Hill, Wolverhampton, as William Corns & Son.

W. R. DELL & SON, LIMITED.—Capital £14,000 in £1 shares (2,500 preference), to acquire the business carried on by W. R. Dell & Son, at 26, Mark Lane, E.C., Croydon, and elsewhere, and to carry on the business of engineers, foundrymen, etc. Registered office: 26, Mark Lane, E.C.

HUTCHING'S PATENTS, LIMITED.—Capital £16,250 in 5s. shares, to carry on the business of engineers, etc., and to adopt agreements (*a*) with Hutching's Patents, Limited, and its liquidator, and (*b*) with J. Hutchings and the said old company and its liquidator. Registered office: 8, Laurence Pountney Hill, E.C.

THEROL FOREIGN PATENTS SYNDICATE, LIMITED.—Capital £2,500 in £1 shares, to acquire and turn to account a certain patent, to adopt an agreement with G. G. Bell and J. St. V. Platts, and to carry on the business of electricians, mechanical engineers, etc. Registered office: Goldhawk Works, Goldhawk Road, W.

H. O'NEILL, LIMITED.—Capital £2,000 in £1 shares, to adopt an agreement with H. O'Neill for the acquisition of the business carried on by him at 25, Denmark Street, W.C., and to carry on the business of manufacturers, factors and agents of brass founders, iron founders, etc. Registered office: 25, Denmark Street, W.C.

BROWN & MURRAY, LIMITED.—Capital £1,000 in 900 preference ordinary and 100 founders' shares of £1 each, to take over the business of telegraph machine makers, general machinists, and engineers, etc., carried on by S. G. Brown and D. Murray, at Mildmay Park Works, Islington, as the "Telegraph Machinery Manufactory."

CORNBROOK ENGINEERING COMPANY, LIMITED.—Capital £1,000 in £1 shares, to acquire the business carried on at Chester Road, Cornbrook, Manchester, as the Cornbrook Engineering Company, Limited, and to carry on the business of ironfounders, engineers, tool makers, etc. Registered office: Chester Road, Cornbrook, Manchester.

ARTHUR SHAW & COMPANY, LIMITED.—Capital £12,000 in £1 shares (8,000 preference), to adopt an agreement with W. O. Wallis and C. E. Rose for the acquisition of the business carried on at the Denver Works, Willenhall, Staffordshire, as Arthur Shaw & Company, and to carry on the business of lock manufacturers and general brassfounders, etc.

SMITH, MAJOR & STEVENS, LIMITED.—Capital £50,000 in £1 shares (60 founders'), to take over the business carried on at Janus Works, Queen's Road, Battersea, and elsewhere, as Archibald Smith & Stevens, to adopt an agreement with C. G. Major, E. C. Stevens, and P. H. Stevens, and to carry on the business of engineers, ironfounders, etc.

YORKSHIRE COPPER WORKS, LIMITED.—Capital £150,000 in £1 shares (100,000 preference), to acquire the undertaking of the Leeds Copper Works, Limited, to adopt an agreement with L. Hirsch & Company, and to carry on the business of metallurgists, manufacturers of and dealers in copper and other metals and metallic alloys and articles made therefrom, etc.

FRANCIS SHAW & COMPANY, LIMITED.—Capital £2,000 in £1 shares, (2,000 5 per cent. cumulative preference), to carry on the business of engineers, millwrights, etc., and to acquire the business carried on by Frances Ann Shaw, at Corbett Street Ironworks, Bradford, Lancashire, and 139, Cannon Street, E.C., and elsewhere, as Francis Shaw & Company. Registered office: Corbett Street, Bradford, Lancs.

JOHN WARNER & SONS, LIMITED.—Capital £22,000 in £1 shares (5,000 preference), to carry on the business of founders, engineers, etc., and to take over the business carried on by G. A. Marriage at Crescent Foundry, Spitalfields, as John Warner & Sons. Registered office: 2, Jewin Crescent, E.C. (John Warner, Limited, of the Iron Foundry, 21, Osborne Street, Whitechapel, have consented to this registration.)

L. HOLLAND & COMPANY, LIMITED.—Capital £10,000 in £1 shares (8,000 preference), to take over the business of brassfounders and tube and stair-rod manufacturers carried on at Bourneville Brassfoundry and Tube Works, Charlotte Road, Stirchley, Worcestershire, as L. Holland & Company, and to adopt an agreement with L. Holland. Registered office: Bourneville Brass Foundry and Tube Works, Charlotte Road, Stirchley, Worcestershire.

DARLINGTON ROLLING MILLS COMPANY, LIMITED.—Capital £30,000 in £1 shares, to adopt an agreement with E. Sisterson, G. E. Sisterson, and R. W. Davies, and to carry on the business of ironmasters and manufacturers, steel converters and manufacturers, engineers, rail and angle-iron makers, rivet manufacturers, boiler and girder makers, bridge and roof builders, makers of railway rolling stock, etc. Registered office: Rise Carr Rolling Mills, Darlington.

Deaths.

MR. W. HARRIS, boiler-maker, Washington Works, Netherton, died recently, aged 79 years.

MR. E. D. CRANE, of the Crane Foundry Company, Horseley Fields, Wolverhampton, died recently, aged 53 years.

THE death is announced of Mr. S. Russell, J.P., of Samuel Russell & Company, Limited, ironfounders, Freer Street, Walsall.

THE death occurred, recently, at his residence, Lichfield Street, Walsall, of Mr. Samuel Russell. Mr. Russell who was about 73 years of age, formerly carried on business as an ironfounder, but retired many years ago.

THE death is reported of Mr. J. Simpson, ironfounder, aged 70 years. The deceased gentleman was at once time a partner in the Dunfermline Foundry Company, and afterwards owned the Phœnix Foundry, in the same town.

THE death occurred suddenly, at 73, Finlay Drive, Denniston, on October 31, of Mr. Alexander Miller, for many years with Walter Macfarlane & Company, Saracen Foundry, and latterly Rennie's Steel Castings Company, in his 54th year.

THE death occurred in Birmingham on November 16 of Mr. F. S. Bolton, a well-known figure in the commercial life of the city. Mr. Bolton, who was 81 years of age, was the second son of the late Mr. Thomas Bolton, the founder of the firm of Thomas Bolton & Sons, copper smelters and wire drawers.

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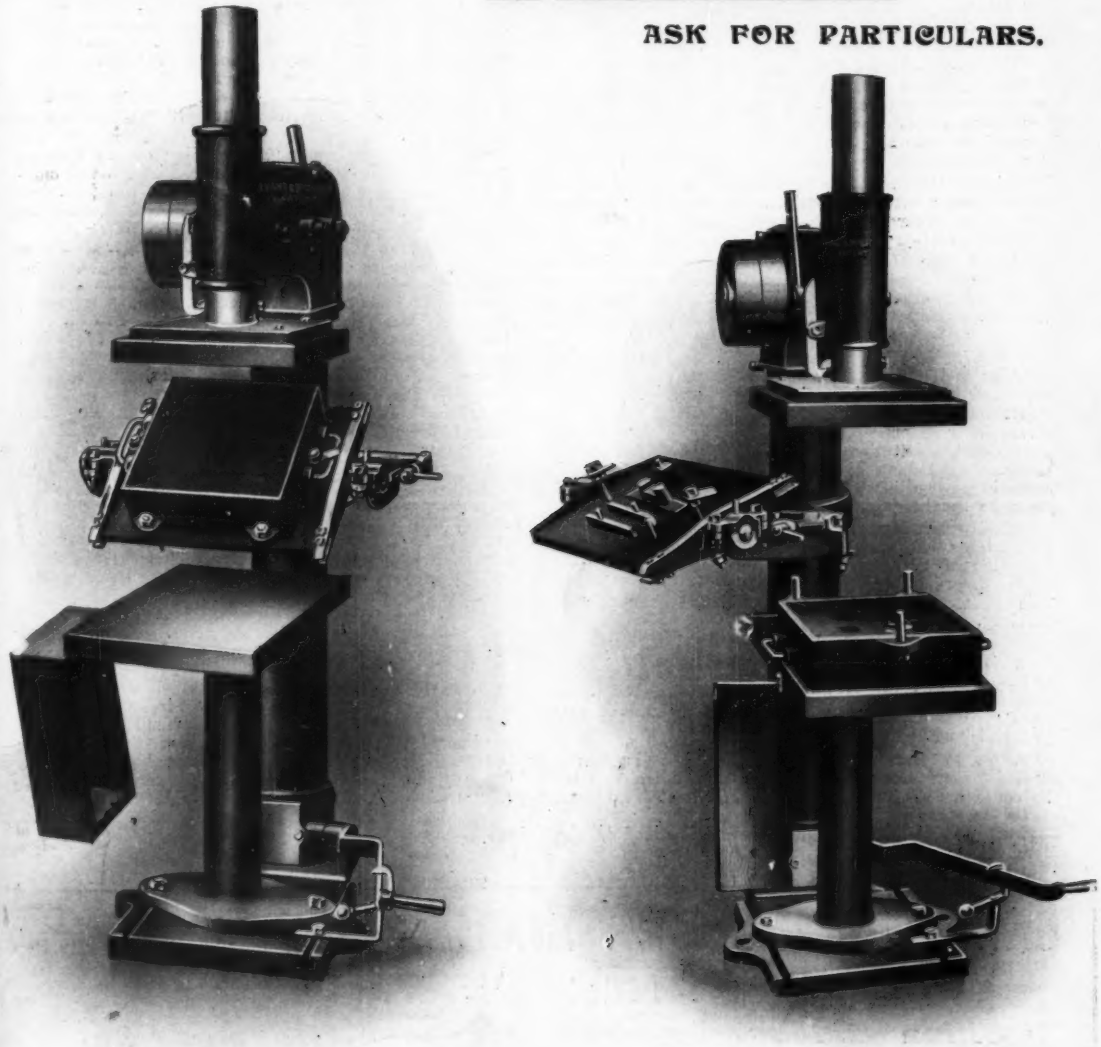

EVERYTHING FOR YOUR FOUNDRY.

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Personal.

THE Council of the Royal Society have awarded the Hughes Medal to Dr. R. T. Glazebrook, for researches on electrical standards.

MR. J. J. DOBBIE, director of the Royal Scottish Museum, has been appointed principal chemist of the Government Laboratories, in room of Sir T. E. Thorpe, retired.

THE late Mr. Alexander Wilson, a director of the North British Locomotive Company, Limited, left personal estate in the United Kingdom valued at £85,976.

THE late Sir Henry James Alderson, a director of Sir W. G. Armstrong, Whitworth & Company, Limited, left estate valued at £13,115 15s. 8d. gross, and £10,731 9s. 9d. net.

MR. T. NEIL, of Coatham, Redcar, has been appointed by the directors of the North-Eastern Steel Company, Limited, as secretary of the company, to succeed the late Mr. John McCrie.

ENGINEER VICE-ADMIRAL H. J. ORAM, C.B., Engineer-in-Chief of the Fleet, has been elected to succeed Mr. J. Swinburne, F.R.S., as President of the Junior Institution of Engineers for the ensuing year.

THE late Mr. T. C. Beeley, of the firm of Thos. Beeley & Son, Limited, Hyde Junction Iron Works, Hyde, near Manchester, who died on June 9, left estate valued at £52,276 gross, with net personalty £33,155.

THE marriage took place at Wakefield, recently, of Mr. J. W. Asquith, a director of W. Asquith, Limited, machine tool makers, Halifax, and a vice-president of the Halifax Branch of the Engineering Employers' Federation.

MR. J. R. FOTHERGILL, Vice-President of the North-East Coast Institution of Engineers and Shipbuilders, has been elected an honorary life member of the Institute, in recognition of his services during the many years he has been connected with the Institute.

MR. H. H. MURRAY, who has been secretary of Richardsons, Westgarth & Company, Limited, from the formation of the company, has been elected to a seat on the Board. Mr. Henry Barnes, until recently the assistant secretary to the company, has been appointed secretary.

MR. G. W. FARRALL, has resigned his position on the staff of the Electric Construction Company, Bushbury, near Wolverhampton, to take up another appointment with the Midland Electric Power Company. He has been the recipient of a presentation from the officials and men.

MR. A. P. COTTERELL, M.Inst.C.E., has been appointed by the Council of the Bristol University, with the concurrence of the Society of Merchant Venturers, as Lecturer on Sanitary Engineering in the Faculty of Engineering, which is provided and maintained in the Merchant Venturers' Technical College.

SIR CHARLES ALLEN, of Henry Bessemer & Company, Limited, Sheffield, has accepted the invitation of the committee to preside on the occasion of the sixty-seventh anniversary festival of the Royal Metal Trades Pension Society, to be held in the hall of the Worshipful Company of Ironmongers, London. The vice-chair will be occupied by Sir W. H. Bailey, Limited, managing director of W. H. Bailey & Company, engineers, Manchester, a director of the Ebbw Vale Steel, Iron, and Coal Company, Limited, and one of the founders of the Manchester Ship Canal.

MR. CHARLES LEONARD AGNEW, of Manchester, has been elected chairman of the board of directors of Galloways, Limited, engineers and boilermakers, Manchester, in the place of Mr. Edward N. Galloway, resigned. Mr. Galloway will retain his seat on the board. We understand that Galloways, Limited, are at present engaged in the electrification of their works and in other respects modernising the plant at the engine works and also the boiler works, the object in view being to reduce cost of production all round and to provide additional facilities for large gas engine manufacture.

THE honours bestowed by the King on the occasion of his birthday, which were announced on November 15, include but few names of interest to the iron and steel industries. Of the new Privy Councillors, Sir Edgar Speyer, Bart, came to London from Frankfort in 1887 to take the direction of Speyer Brothers, the London house of the financial firm of Speyer, which has houses also in Frankfort and New York. He is principally interested in the London underground railways. Sir Henry Enfield Roscoe, F.R.S., the distinguished chemist, who will be 76 next January, was Professor of Chemistry at Owens College, Manchester, for 30 years, from 1857 to 1887, and has served on a number of Royal Commissions. The new baronets include Mr. William John Crossley, M.P., the second son of the late Major Francis Crossley. He was born in 1844, at Glenburn, Dunmurry, Ireland. He was articled as an engineer with Sir W. G. Armstrong & Company, Elswick, in 1862, and started business in partnership with his late brother, Mr. F. W. Crossley, of Manchester, in 1867. The firm took up gas-engine manufacture in 1869, and were the founders in England of what has now become a great trade. Mr. Crossley was a director of the Manchester Ship Canal Company from the beginning until his retirement in 1906, and is a freeman of Manchester. A knighthood has been conferred on Mr. Arthur Trevor Dawson, who is a director and superintendent of ordnance in the firm of Vickers, Sons & Maxim, Limited, and a director of several other companies, including Whitehead Torpedo Works (Weymouth), Limited, William Beardmore & Company, Limited, and the Wolseley Tool and Motor Car Company, Limited. A similar honour has been conferred on Professor William Augustus Tilden, D.Sc., F.R.S., who was Professor of Chemistry at the Royal College of Science in 1904-5. In the latter year he was appointed Dean of the College.

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FIRE CLAY.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
STEEL MOULDERS' COMPOSITION, SILICA CEMENT.
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BRITISH
ADMIRALTY DOCKYARDS.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Navigation Collieries, Ltd., Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

METALS.	End Nov., 1909.	End Nov., 1908.
Iron—Scotch pig warrants ton	*56/10½	*55.6
—Middlesbro' warrants .. ton	51 0	49 6½
—W.C. M/nos Bessemer ... ton	61 6	59 6
—Stock, Scotch ... ..tons	1,000	1,000
Copper—Chill bars, GMB ton	£59 11 3	£63 15/0
—Stock, Europe and afloat tons	†102,952	52,835
Tin—English ingots ... ton	£138 0 0	£136 0/0
—Straits ... ... ton	£142 5 0	£135 17/6
—Stock, London, Holland, U.S.A., and afloat ...tons	‡19,68[illegible]	—
Lead—English pig ... ton	£13 8 9	£13 17/6
Spelter—Ord. Silesian ... ton	£23 5 0	£21 6 3
Quicksilver (75lb)... bottle	£9 17 6	£8 10 0
Antimony—Regulus ... ton	£29 10/0	£32 10/0 £34 10/0

* Settlement price. † Nov. 15th. ‡ Oct. 31st.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	6 15 0
Pipes, 1½ to 2½ in.	4 17 6	to	5 2 6
,, 3 to 4 in.	4 10 0	to	5 0 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in.	4 7 6	to	4 10 0
,, 18 to 24 in.	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 2 6	to	3 5 0

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 8s. 0d.; light wrought, £1 1s. 0d.; heavy cast, £2 7s. 0d.; all per ton f.o.b., London. Copper (clean), £51 0s. 0d.; brass (clean), £39 0s. 0d.; lead (usual draft), £12 10s. 0d.; tea lead, £11 10s. 0d.; zinc, £18 15s. 0d.; all per ton delivered merchant's yard.

WE are informed that the Council of the Institution of Civil Engineers have just concluded arrangements with H.M. Office of Works for purchasing the site for their new building. The freehold area acquired, inclusive of 6, Great George Street, Westminster, S.W., which the Council already held, will provide an extensive site for the proposed buildings. The Council have already invited competitive designs, and expect to make a start early next year, and to occupy the new buildings in 1912.

THE proprietors of the "Engineering Review" have decided to promote an Engineering and Machinery Exhibition to be held in Manchester in the autumn of 1910. A hall has been secured which is the largest outside London, and is one of the best appointed exhibition buildings in the Kingdom. Further, the services of Mr. Walter Cawood, manager of the Gas Exhibition of 1907, etc., have been secured as manager. Amongst the reasons that have actuated the proprietors of the "Engineering Review" in taking up this matter are, that no purely Engineering and Machinery Exhibition has been held in Manchester since 1887, and that no better time could be chosen than when, as now, trade, after a period of depression, has taken an upward turn. The Exhibition will open on October 14 and close on November 5, 1910.

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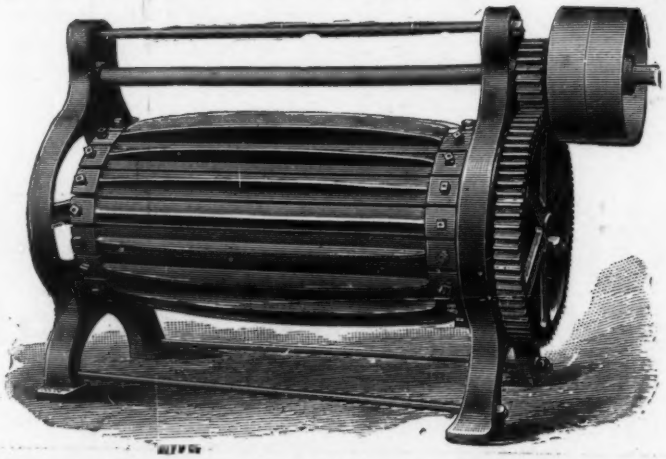

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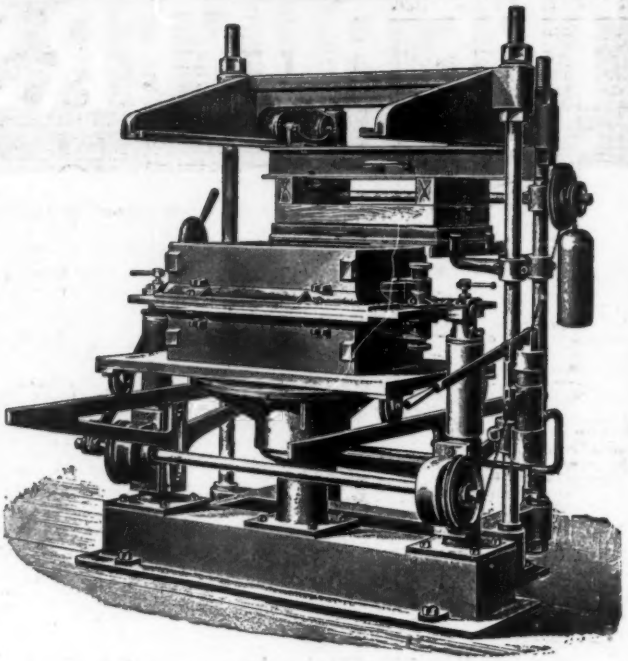

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THE BUYER'S GUIDE

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THE BUYER'S GUIDE.—*Continued.*

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Bush, Henry C.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall, H. P., & Co.
Phillips, J. W. & C. J.
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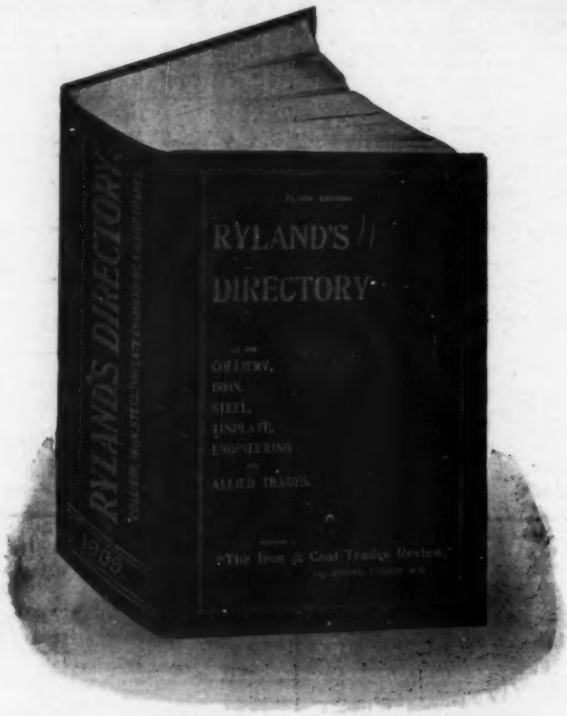

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